T-BERD 209A T-CARRIER ANALYZER OPERATING MANUAL

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1. GENERAL

1.01 This section provides an overview of Telecommunications Techniques Corporation's (TTC's) T-BERD 209A T-Carrier Analyzer. Emphasis is placed on the T-BERD 209A's primary features and operational characteristics.

1.02 This is the first issue of this manual. When this manual is reissued, this paragraph will contain the reason for reissue.

1.03 The T-BERD 209A is a portable test instrument that comprehensively analyzes T1 and T1C transmission systems. Used in the central office and in the field, the T-BERD 209A is used during circuit installation, acceptance testing, and fault isolation.

1.04 In the central office, the T-BERD 209A can either generate and receive test patterns for out-of-service testing or monitor T1 and T1C circuits without service interruption. In the field, the instrument detects and isolates problems related to customer-owned equipment (e.g., Customer Service Unit (CSU)) and detects problems originating from the T1 span line; no CSU is required for span line testing.

1.05 The T-BERD 209A offers these key features and characteristics:

(1) **D4, ESF, and SLC*-96 Framing Patterns** offer compatibility with a variety of framing formats. An unframed mode is also available for applications where framing is not required.

(2) **Summary Test Results** category displays key non-zero and ''out-of-spec'' results, eliminating the need to search through long lists of test results.

(3) **Automatic Configuration Mode** lets the T-BERD 209A configure the proper line rate (T1 or T1C), framing, coding, and pattern. No set-up is required when monitoring live circuits.

(4) **Simultaneous Logic Error, Bipolar Violation, and Frame Error Analysis** with associated error rate, errored seconds, and percent error-free seconds calculations.

(5) **Signal Analysis** with simplex current, signal level, timing slip, and recovered clock frequency measurements.

(6) **Pulse Shape Analysis** allows you to measure the height, width, rise time, fall time, overshoot and undershoot of a T1 pulse. Pulse shapes can also be measured for conformance to AT&T Compatibility Bulletin 119 or proposed ANSI specification T1.C1-NI.

(7) **Slips and Wander** measurements identify wander impairments or the potential for frame slips.

(8) **Logic, BPV, and Frame Error Insertion** enables the T-BERD 209A to simulate errors as they actually occur. Errors may be inserted singly, in a burst, or at variable rates.

(9) **RS-232 Printer/Remote Control Interface** allows you to print graphic displays (e.g., pulse shapes) and error analysis results, and to remotely control the T-BERD 209A.

(10) **Results History Buffer** stores up to 12 sets of your most recent test results.

(11) **Optional Battery Operation** allows up to 4 hours of continuous, cord-free instrument use.

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2. INSTRUMENT DESCRIPTION

2.01 This section describes the T-BERD 209A T-Carrier Analyzer, with special emphasis on the instrument's measurement capabilities. It includes descriptions of the T-BERD 209A's operating modes, front panel switches, indicators, displays, and connectors. A discussion of the T-BERD 209A's pull-out reference card is offered at the conclusion of the section.

Operating Modes

2.02 The T-BERD 209A provides in-depth testing capabilities for T1 and T1C circuits. T1 modes include:

(1) *Unframed* for compatibility with existing test equipment or circuits where framing is not required.

(2) *Framed* for testing circuits which include multiplexers and Digital Access and Cross-Connect Switches (DACS) through which only framed data can pass. T1 framing modes include D4, ESF, and SLC-96 data formats.

(3) *Test Loopback and Line Loopback* for emulating a CSU when installing or troubleshooting T1 spans.

2.03 In addition to T1 mode, the T-BERD 209A offers two T1C modes (T1C and T1C TLB) which can be used for T1C link testing. Other modes of operation include an Auxiliary mode which allows parameters to be set for functions without dedicated switches, and a Self-Test mode with ESF (Fe) framing and internal 1.544 MHz oscillator timing.

Front Panel

2.04 This section describes the T-BERD 209A's switches, indicators, and connectors. Figure 1 depicts the front panel of the T-BERD 209A. The numbers for each item in the figure correspond to the numbered descriptions which follow in paragraphs 2.07 through 2.10.

A. Switches

2.05 The T-BERD 209A features two types of switches:

(1) Multiposition rocker switches

(2) Pushbutton switches

2.06 The multiposition rocker switches feature LED indicators which are illuminated to show the current setting of the switch. Several of the pushbutton switches feature LED indicators which are illuminated only under certain conditions.

2.07 The front-panel switches available on the T-BERD 209A front panel are described in the paragraphs immediately following:

(1) MODE—The MODE switch controls the selection of the transmit and receive line rate and the framing format for the T-BERD 209A. Hold down the MODE switch to scroll through the instrument's available operating modes; the names of the operating modes appear on the top line of the display immediately above the switch. Select an operating mode by releasing the switch when the mode appears in the display. The operating modes that can be selected using the MODE switch are as follows:

(a) *T1* allows data to be transmitted at the T1 rate using an unframed data format.

(b) *T1 D4, T1 ESF, and T1 SLC* allow data to be transmitted at the T1 rate in a framed data format. The T1 D4 and T1 ESF modes specify D4 and ESF (Fe) framing, respectively. The T1 SLC mode monitors T1 lines that use the SLC-96 data format by ignoring the framing bits that are used as a data link. In T1 SLC mode, data is transmitted with SLC data link (Fs) bits set to all zeros.

NOTE: The D4 framing pattern is compatible with D1D, D2, and D3 framing formats.

(c) *T1 TLB* causes the T-BERD 209A to retransmit the data it receives. Incoming BPVs are stripped; BPVs, logic errors, frame errors, and B8ZS line code can be inserted into the retransmitted data stream. In T1 TLB mode, the T-BERD 209A's receiver automatically accepts the type of data being transmitted (i.e., framed or unframed).

(d) *T1 LLB* enables the T-BERD 209A's receiver to automatically accept the type of data being transmitted (i.e., framed or unframed). In T1 LLB mode, the T-BERD 209A also acts as a repeater—all data received by the T-BERD is echoed by the transmitter. BPVs are not stripped, nor can BPV, logic, or frame errors be inserted into the data stream. Line coding is not selectable.

(e) *T1C* transmits data at the T1C rate using an unframed data format.

(f) *T1C TLB* causes the T-BERD 209A to retransmit the data it receives. Incoming BPVs are stripped and BPVs, logic errors and B8ZS line code can be inserted into the retransmitted data stream.

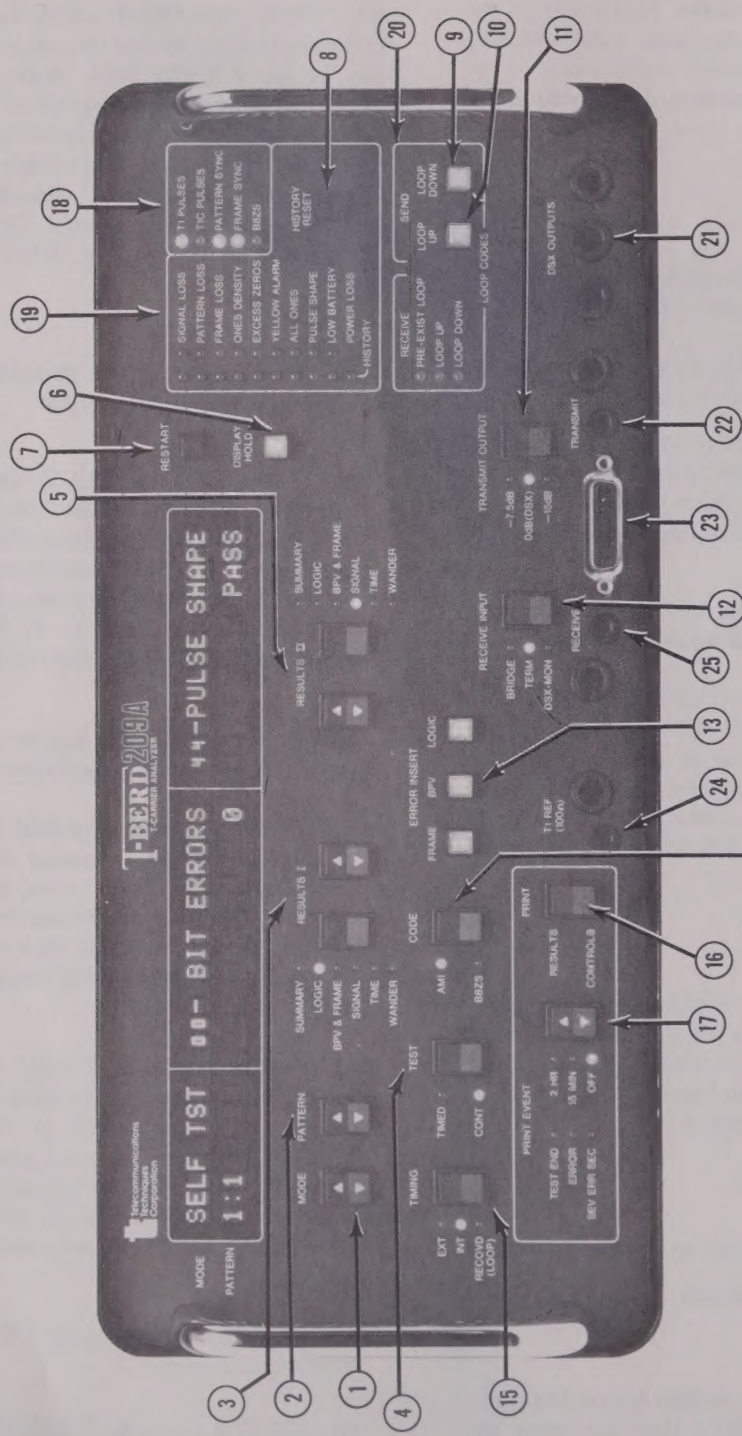

Figure 2-1—T-BERD 209A Front Panel

(g) *AUX* allows operating parameters to be set for functions where dedicated switches are not provided. When AUX mode is selected, the PATTERN display shows the currently selected auxiliary function. Press the PATTERN switch to scroll the available auxiliary functions into the display.

Once the desired auxiliary function is in the display, you can modify the function's parameters using the ⇕ switches of the RESULTS I and RESULTS II categories. Note that the use of these switches varies with each auxiliary function. The upper line of the display above each RESULTS category shows how the UP ARROW (▲) and DOWN ARROW (▼) switches are currently used. Each auxiliary function is described in detail under Auxiliary Functions.

(h) *SELF TST* loops the transmit output to the receive input to perform a self-test. In SELF TST mode, data is transmitted at the T1 rate in the ESF framed format. Additionally, the internal clock source is used regardless of the position of the TIMING switch (see Switch 15). When leaving SELF TST mode, the timing source reverts to the current position of the TIMING switch.

(i) *AUTO* enables the T-BERD 209A to automatically configure itself to the received line rate, framing format, and coding when monitoring a live circuit. When auto-configuration is successful, both the received mode and pattern are displayed in lower-case letters. When the received pattern is not recognized (e.g., when live data is being monitored), the word "live" is displayed.

NOTE: With the exception of AUX mode, changing modes causes a test restart (.75 seconds after the switch is released).

(2) PATTERN—The PATTERN switch selects the data pattern to be transmitted and informs the T-BERD 209A's receiver which data pattern to expect.

Hold down the PATTERN switch to scroll through the instrument's available data patterns; the names of the data patterns appear on the second line of the display immediately above the switch. Select a data pattern by releasing the switch when the desired pattern appears in the display.

NOTE: Changing data patterns causes a test restart.

The data patterns that are selectable using the PATTERN switch are as follows:

(a) ALL ONES, 1:1, 1:7, 3 IN 24—fixed data patterns (described in Section 7).

(b) 2^{15}-1, 2^{20}-1, 2^{23}-1—pseudorandom data patterns.

(c) T1 QRSS - simulates live data for T1 applications. T1 QRSS is a 2^{20}-1 pattern with 14-zero suppression. This pattern can also be used for T1C testing.

(d) T1C QRSS—simulates live data for T1C applications. Like T1 QRSS, T1C QRSS is a 2^{20}-1 pattern; however, there is no zero suppression.

(e) USER1 and USER2—selects the user-defined bit data pattern specified by the USER1 and USER2 auxiliary functions, respectively (see Auxiliary Functions). The data pattern that you specify can be from 3 to 24 bits in length.

Using the T-BERD 209A's remote control feature, you may specify a descriptive label (seven-character maximum) to replace the factory-set USER1 and USER2 labels in the display (see Remote Control Commands). The label and pattern that you define are both stored in non-volatile memory. The default data patterns for USER1 and USER2 are 1:6 and 1:5, respectively.

NOTE: The LOOP UP and the LOOP DOWN switches override the currently selected data pattern. When either switch is pressed, the name of the currently selected loop code pattern is displayed in place of the pattern name. When loop code transmission is terminated, the data pattern overridden by the loop code reappears in the display.

(3) RESULTS I—The RESULTS I area consists of two switches which enable you to view test results in the T-BERD 209A's middle display:

(a) A six-position switch with adjacent LED indicators.

(b) A two-position rocker switch ⇕.

The six-position switch selects one of the T-BERD 209A's six results categories: SUMMARY, LOGIC, BPV & FRAME, SIGNAL, TIME, and WANDER. The ⇕ switch allows you to view the results that are available in each results category. When you hold this switch down for more than 1 second, you can automatically scroll through the entire list. You can also scroll forward (▲) or backward (▼) through the list.

NOTE: The ⇕ switch is also used in setting auxiliary functions (see Auxiliary Functions).

(4) TEST—This two-position switch controls test duration. The CONTINUOUS TEST position enables unlimited test duration. The TIMED position allows you to conduct a timed test of up to 200 hours and 59 minutes. The factory default setting is 200 hours.

NOTE: Changing from CONTINUOUS TEST to TIMED TEST causes a test restart; however, changing from TIMED TEST to CONTINUOUS TEST allows the time test to continue (i.e., test results continue to accumulate).

(5) RESULTS II—The RESULTS II switches control the test results that are viewed in the T-BERD 209A's right-most display. Both switches are functionally identical to the RESULTS I switches.

NOTE: The ▲▼ switch is also used in setting auxiliary functions (see Auxiliary Functions).

(6) DISPLAY HOLD—DISPLAY HOLD is a pushbutton switch that freezes the T-BERD 209A's result displays and alarm and status LEDs at the moment the switch is pressed. When active, a LED within the switch is illuminated to indicate that your displayed results are not current. If the switch is pressed again while the LED is illuminated, the current test results and LED displays are returned to the front panel.

(7) RESTART—RESTART is a pushbutton switch that restarts any test in progress. When pressed, all test results and history indicator LEDs (see Indicators) are cleared. You can also use the RESTART switch to exit AUX mode and reenter your previous mode selection.

(8) HISTORY RESET—HISTORY RESET is a pushbutton switch that clears all history indicator LEDs. Note that this switch does not restart a test, nor does it affect any of the current LED indicators or accumulated test results. This switch is not operable when the DISPLAY HOLD switch is activated.

(9) LOOP DOWN—This pushbutton switch controls the transmission of loop-down code. When the LOOP DOWN switch is pressed, loop-down code is continuously transmitted until one of the following conditions occurs:

(a) The loop-down code is no longer detected at the T-BERD's receiver.

(b) The LOOP DOWN switch is pressed again.

(c) The MODE, PATTERN, RESTART, RECEIVE INPUT, or TIMING switch is pressed.

The LED within the LOOP DOWN switch is illuminated for the duration of loop-code transmission. The switch is disabled in T1 TLB, T1 LLB, and T1C TLB modes.

The type of loop-down code that is transmitted is controlled by the LP CODE auxiliary function.

NOTE: The LOOP DOWN switch overrides the currently selected data pattern; when pressed, the currently selected loop-down pattern is displayed in place of the pattern name. When loop code transmission is terminated, the data pattern overridden by the loop code reappears in the display.

(10) LOOP UP

This pushbutton switch controls the transmission of loop-up code. When the LOOP UP switch is pressed, loop-up code is continuously transmitted until one of the following conditions occurs:

(a) The loop-up code is detected at the T-BERD's receiver.

(b) The LOOP UP switch is pressed again.

(c) The MODE, PATTERN, RESTART, RECEIVE INPUT, or TIMING switches is pressed.

The LED within the LOOP UP switch is illuminated for the duration of loop-code transmission. The switch is disabled in T1 TLB, T1 LLB, and T1C TLB modes.

The type of loop-down code that is transmitted is controlled by the LP CODE auxiliary function.

NOTE: The LOOP UP switch overrides the currently selected data pattern; when pressed, the current loop-up pattern is displayed in place of the pattern name. When loop code transmission is terminated, the data pattern overridden by the loop code reappears in the display.

(11) TRANSMIT OUTPUT

TRANSMIT OUTPUT is a three-position switch that allows emulation of three different cable losses for T1 rates (−7.5 dB, 0 dB, or −15 dB). The selected cable loss affects the transmit data only at the 15-pin D connector, the transmit bantam connector, and the transmit 310 jack. The current setting of this switch is indicated by the illumination of the appropriate LED.

NOTE: When the MODE switch is set to T1C, the 0dB (DSX) position of the TRANSMIT OUTPUT switch is automatically selected.

(12) RECEIVE INPUT

RECEIVE INPUT is a three-position switch that allows the selection of input impedance and signal conditioning (BRIDGE, TERM, and DSX-MON).

BRIDGE provides an input impedance greater than 1000 ohms for monitoring lines that are already terminated. TERM provides an input impedance of 100 ohms. Both the BRIDGE and TERM provide Automatic Line Build-out (ALBO) compensation which adjusts for up to 35 dB of cable loss for T1 or 6 dB of cable loss for T1C.

DSX-MON provides both 100 ohms of input impedance and amplification of the input signal. DSX-MON is useful for monitoring T1/T1C lines at DSX monitor points which are resistor-isolated.

NOTE: Changing the position of the RECEIVE INPUT switch causes a test restart.

(13) ERROR INSERT

The ERROR INSERT switches control the insertion of errors into the data stream. Three independent pushbuttons are offered:

(a) FRAME switch

(b) BPV switch

(c) LOGIC switch

Each switch features an internal LED that is illuminated during error insertion. Additionally, these switches can be used in combination with one another to insert frame errors, BPVs, and logic errors simultaneously.

FRAME

The FRAME switch causes logic errors to be inserted on transmitted synchronization bits (i.e., Ft bits in D4 and SLC, and Frame Pattern Sequence (FPS) bits in ESF).

In SINGLE ERROR mode, pressing the FRAME switch for less than 1 second causes a single frame error to be inserted; in such instances, the LED indicator is briefly illuminated. Pressing the FRAME switch for longer than 1 second causes 1 frame error to be inserted in every superframe.

In MULTIPLE ERROR mode, pressing the FRAME switch for less than 1 second causes a variable number of frame errors (2–6) to be inserted during 1 superframe; in such instances, the LED indicator blinks 3 times.

Pressing the FRAME switch for longer than 1 second causes a variable number of frame errors (2 to 6) to be *continuously* inserted in each superframe until the switch is pressed again; in such instances, the LED indicator is continuously illuminated.

Both the mode in which frame errors are transmitted (SINGLE ERROR or MULTIPLE ERROR) and the number of consecutive frame errors to be transmitted (2 to 6) are selected using the FRM ERR auxiliary function (see Auxiliary Functions).

BPV

The BPV switch causes bipolar violation errors to be inserted on any of the transmitted bits.

In SINGLE ERROR mode, pressing the BPV switch for less than 1 second causes a single BPV error to be inserted; in such instances, the LED indicator is briefly illuminated.

In BURST ERROR mode, pressing the BPV switch for less than 1 second causes a burst of BPV errors of variable length and rate; in such instances the LED indicator blinks 3 times.

Pressing the BPV switch for longer than 1 second causes BPV errors to be *continuously* inserted at the selected rate until the switch is pressed again; in such instances, the LED indicator is continuously illuminated.

The BPV error insertion mode (SINGLE or BURST) and burst length are selected using the ERR SEL auxiliary function (see Auxiliary Functions). The rate at which errors are inserted is selected using the ER RATE auxiliary function. Note that the settings of these auxiliary functions also apply to logic error insertion.

LOGIC

The LOGIC switch causes logic errors to be inserted on any of the transmitted bits.

In SINGLE ERROR mode, pressing the LOGIC switch for less than 1 second causes a single logic error to be inserted; in such instances, the LED indicator is briefly illuminated.

In BURST ERROR mode, pressing the LOGIC switch for less than 1 second causes a burst of logic errors of variable length and rate; in such instances, the LED indicator is illuminated for 1 second.

Pressing the LOGIC switch for longer than 1 second causes logic errors to be *continuously* inserted at the selected rate until the switch is pressed again; in such instances, the LED indicator is continuously illuminated.

The logic error insertion mode (SINGLE or BURST) and burst length are selected using the ERR SEL auxiliary function (see Auxiliary Functions). The rate at which logic errors are inserted is selected using the ER RATE auxiliary function. Note that the settings of these auxiliary functions also apply to BPV error insertion.

Logic and BPV errors can be inserted on all transmitted data except where T1 LLB mode is selected. When inserting logic errors and BPVs simultaneously, errors are inserted without regard to B8ZS sequences, which may cause the same kind of error multiplication as is encountered on a repeatered span.

(14) CODE—CODE is a two-position switch that determines whether the T-BERD 209A transmits with normal AMI-encoded data or B8ZS clear-channel encoding. LEDs adjacent to each switch label are illuminated to show the current selection.

The CODE switch only affects the transmitter; B8ZS decoding is performed automatically on the receive side. The B8ZS status LED (see Indicators) is illuminated when zero substitution codes are detected.

NOTE: When B8ZS code is detected in instances where the CODE switch is set to the AMI position, the message B8ZS DETECTED is displayed in the SUMMARY results category.

(15) TIMING—TIMING is a three-position switch that selects the transmit timing source. LEDs adjacent to each label are illuminated to show the current position of the switch (EXT, INT, or RECOVD LOOP).

When the TIMING switch is set to EXT, the T-BERD 209A takes transmit timing from either the external clock source attached to the BNC connector on the instrument's right side-panel or from the T1 REF input on the front-panel as follows:

WHEN BNC TIMING IS:	AND T1 REF TIMING IS:	THE EXTERNAL CLOCK SOURCE IS:
PRESENT	NOT PRESENT	BNC
NOT PRESENT	PRESENT	T1 REF
PRESENT	PRESENT	BNC
NOT PRESENT	NOT PRESENT	Not available; EXT LED flashes.

When the TIMING switch is set to INT, transmit data is generated by the T-BERD 209A's internal crystal oscillator at either T1 or T1C rates (as selected by the MODE switch).

When the TIMING switch is set to RECOVD (LOOP), the transmit timing source is taken from the clock signal recovered from the received data. When choosing recovered timing in any T1 mode (except one of the loop modes—T1 TLB or T1 LLB), jitter is removed from the clock signal before it is used as the transmit source.

NOTE: In Self-Test Mode, timing is set to INT regardless of the current setting of the TIMING switch. In T1 TLB, T1 LLB, and T1C TLB modes, timing is set to RECOVD regardless of the current setting of the TIMING switch.

(16) PRINT—PRINT is a two-position switch that generates a printout whenever either position is pressed. The RESULTS position generates a printout of the current test results. The CONTROLS position generates a printout of the current configuration of the T-BERD 209A.

(17) PRINT EVENT—PRINT EVENT is a six-position switch which determines the events that automatically initiate a printout. When the switch is set to the OFF position, no status or alarm messages are printed; all other positions enable the printing of status and alarm messages. The print event selections are:

(18) TEST END—If the T-BERD 209A is set for a timed test, results are logged to the printer when the test interval is complete.

(19) ERROR—Results are logged to the printer when any of the following events occur:

(a) Logical bit errors

(b) CRC errors

(c) Frame errors

(d) BPVs

(e) Changes in alarm conditions

(20) SEVERELY ERROR SEC—Results are logged to the printer when the bit error rate exceeds 1×10^{-3}.

(21) 2 HR—Results are logged to the printer at 2-hour test intervals.

(22) 15 MIN—Results are logged to the printer at 15-minute test intervals.

B. Auxiliary Functions

2.08 Auxiliary functions allow access to activities that do not have dedicated switches. Auxiliary functions are

available by setting the MODE switch to the AUX position. Each specific auxiliary category is accessed through and displayed above the PATTERN switch. This section of the manual describes each auxiliary function and gives instructions for setting the related parameters.

USER1

USER1 allows you to program a data pattern of your own choosing. When USER1 is selected, the current user pattern appears in the lower display line and the functions of the RESULTS I and RESULTS II switches appear in the upper display line.

AUX FORWARD/\ REV\/ TOGGLE/\END\/
USER1 000111000111 000111000111

The first bit of the currently selected pattern blinks to indicate the edit position. Use the following procedure to change the programmable pattern.

(1) Press the RESULTS I switch until the bit you wish to change is blinking. The up (▲) arrow controls FORWARD movement; the down (▼) arrow controls REVerse movement.

(2) Press the RESULTS II switch's up arrow to TOGGLE the bit from "1" to "0" or "0" to "1".

(3) Repeat Steps 1 and 2 until you have set the final bit in the pattern.

(4) With the last bit in the pattern blinking, press the RESULTS II switch's down arrow to END the pattern. This step must be performed to save the new data pattern.

RESULT: All bits to the right of the blinking bit are deleted. The first bit in the pattern blinks to indicate that your newly programmed data pattern is being displayed.

USER2

USER2 allows you to set a second data pattern of your own choosing. The data pattern is set in the same manner as USER1.

PGM LPUP

PGM LPUP allows you to define a 3- to 8-bit loop-up code of your own choosing. When the PGM LPUP auxiliary function is selected, the following lines appear in the display. The lower RESULTS I display line shows the current loop code setting.

AUX FORWARD/\REV\/ TOGGLE/\ END\/
PGM LPUP 10000

The procedure for programming loop-up codes is similar to setting a user-programmable data pattern. To change the loop code sequence, perform the following procedure.

(1) Press the RESULTS I switch until the bit you wish to change is blinking. The up (▲) arrow controls FORWARD movement; the down (▼) arrow controls REVerse movement.

(2) Press the RESULTS II switch's up arrow to TOGGLE the bit from "1" to "0" or "0" to "1".

(3) Repeat Steps 1 and 2 until you have set the final bit in the pattern.

(4) With the last bit in the pattern blinking, press the RESULTS II switch's down arrow to END the pattern. This step must be performed to save the new loop-up code.

RESULT: All bits to the right of the blinking bit are deleted. The first bit in the pattern blinks to indicate that your newly programmed loop-up code is being displayed.

PGM LPDN

PGM LPDN allows you to define a 3- to 8-bit loop-down code of your own choosing. When the PGM LPDN auxiliary function is selected, the following lines appear in the display. The lower RESULTS I display line shows the current loop code setting.

AUX FORWARD/\REV\/ TOGGLE/\ END\/
PGM LPDN 100

The procedure for programming loop-down codes is identical to programming loop-up codes. To change the loop code sequence, perform the following procedure.

(1) Press the RESULTS I switch until the bit you wish to change is blinking. The up (▲) arrow controls FORWARD movement; the down (▼) arrow controls REVerse movement.

(2) Press the RESULTS II switch's up arrow to TOGGLE the bit from "1" to "0" or "0" to "1".

(3) Repeat Steps 1 and 2 until you have set the final bit in the pattern.

(4) With the last bit in the pattern blinking, press the RESULTS II switch's down arrow to END the pattern. This step must be performed to save the loop-down code that was entered.

RESULT: All bits to the right of the blinking bit are deleted. The first bit in the pattern blinks to indicate that your newly programmed loop-down code is being displayed.

PARITY

This auxiliary function sets the RS-232 Printer/Remote Controller Interface's parity. Parity settings are EVEN, ODD, or NONE. When the PARITY auxiliary function is selected, the following lines appear in the display.

AUX PARITY
PARITY EVEN

The current value for parity is shown in the lower line of the RESULTS I display. You can change the value to ODD or NONE by pressing the RESULTS I ⇕ switch.

HALT/CONT

HALT/CONT controls the T-BERD 209A's reaction to a loss of pattern synchronization. The lower RESULTS I display shows the current setting.

AUX HALT/CONTINU
HLT/CONT HALT

HALT freezes all LOGIC results when a synchronization loss is declared; the test resumes when synchronization is reacquired. CONTINUOUS causes the error and slip counts to continue throughout the synchronization loss. HALT is the factory-set selection.

NOTE: Changing the setting of this auxiliary function in mid-test causes a test restart.

PRNT FMT

PRNT FMT controls the print format used with the Printer/ Remote Controller Interface. The lower RESULTS I display shows the format setting.

AUX FORMAT
PRNT FMT SHORT FORMAT

NORMAL FORMAT specifies the printing of all test results. SHORT FORMAT specifies an abbreviated print format. SUMMARY enables all applicable test results in the summary category to be printed.

TERM

AUX TERMINATOR
TERM CRLF

TERM allows you to select either a carriage return (CR) or a carriage return-line feed pair (CRLF) as the printer/remote control line termination character.

PLS MASK

PLS MASK controls the selection of pulse mask specification.

AUX PULSE SELECT
PLS MASK DSX (CB119)

DSX (CB119) selects the pulse mask conforming to AT&T Compatibility Bulletin 119. NI (ANSI) selects the pulse mask conforming to the proposed ANSI T1.403 Network Interface specification. NONE specifies that the pulse shape is not evaluated for conformance to either pulse mask specification. When NONE is selected, the PULSE SHAPE LED indicator (see Indicators) is disabled and no mask appears on the pulse shape printout. NONE is the default selection.

RES HIST

RES HIST serves as a display buffer that stores the 12 most recent sets of test results that were sent to the T-BERD 209A's print buffer.

AUX HISTORY RESULT ALL RESULTS
RES HIST 12AUG 09:20:17 OK

The RESULTS I display indicate the date and time of the currently selected results print. The RESULTS I ⇕ switch is used to select any of the stored results prints stored in the display buffer. The RESULTS II display shows the test results associated with the results print specified in the RESULTS I display. The RESULTS II switches allow you to bring the stored results in each test category into the RESULTS II display.

ERR SEL

ERR SEL lets you control the way in which BPV and logic errors are inserted into the transmitted data stream. The lower RESULTS I display shows the currently selected value (SINGLE ERROR or burst increment).

AUX BPV / LOGIC
ERR SEL SINGLE ERROR

SINGLE ERROR inserts a single BPV or logic error into the data stream whenever the BPV or the LOGIC switch is pressed for less than 1 second. If you choose to insert a burst of BPV or logic errors, you can use the RESULTS I ⇕ switch to select:

(a) 25 ms. to 200 ms. in increments of 25 ms.

(b) 250 ms. to 500 ms. in increments of 50 ms.

(c) 600 ms. to 1.5 seconds in increments of 100 ms.

(d) 2.0 seconds to 5.0 seconds in increments of 500 ms.

FRM ERR

FRM ERR lets you control the way in which frame errors are inserted into the transmitted data stream. The lower RESULTS I display shows the currently selected value (SINGLE ERROR or the number of consecutive frame errors inserted).

AUX	FRM ERR INS
FRM ERR	SINGLE ERROR

SINGLE ERROR inserts a single frame error into the data stream whenever the FRAME switch is pressed for less than 1 second. If you choose to insert multiple frame errors, you can use the RESULTS I switch to select a value of 2–6 consecutive frame error insertions.

ER RATE

ER RATE controls the error insertion rate by which BPV and logic errors are transmitted into the data stream.

AUX	ERROR RATE
ER RATE	1.0 E-6

The RESULTS I switch is used to set error rates from 1.0 E-9 to 1.0 E-2.

CLOCK

CLOCK sets the current clock time. The clock time that you set appears on all printouts generated by the T-BERD 209A. It is also used with the PRINT EVENT function to inform you when an event of interest has occurred.

AUX	HOUR	MINUTE
CLOCK	13	31

The RESULTS I switch increments/decrements the HOUR display. The RESULTS II switch increments/decrements the MINUTE display.

When selecting the clock auxiliary function, note that the time displayed may differ from the actual clock time. Additionally, no change in the time setting occurs unless the RESULTS I and RESULTS II switches are used.

DATE

DATE sets the current date. The date that you set appears on all printouts generated by the T-BERD 209A. Like the CLOCK auxiliary function, it is also used with the PRINT EVENT function to inform you when an event of interest has occurred.

AUX	MONTH	DAY
DATE	NOVEMBER	12

The RESULTS I switch increments/decrements the MONTH display. The RESULTS II switch increments/decrements the DAY display.

TEST LEN

TEST LEN sets the length of a test when the T-BERD 209A is in the timed test mode.

AUX	HOUR	MINUTE:SECOND
TEST LEN	200	0:00

Using this auxiliary function, the test length can be specified as follows:

(1) 15 seconds to 1 minute in 15-second intervals

(2) 1 minute to 200 hours/59 minutes in 1-minute intervals

The RESULTS I switch increments/decrements the HOUR display. The RESULTS II switch increments/decrements the MINUTE:SECOND display.

PWR SAVE

When enabled, PWR SAVE automatically turns off the T-BERD 209A's displays if none of the T-BERD 209A's switches have been pressed within 5 minutes. When the displays are dark, pressing any of the T-BERD 209A's switches restores power without changing the position of the switch. The RESULTS I switch turns the PWR SAVE function ON or OFF.

AUX	POWER SAVE
PWR SAVE	ON

By automatically powering down the T-BERD 209A during unmonitored periods, the PWR SAVE function can extend the life of your battery as much as 25%.

NOTE: This auxiliary function is only available when the T-BERD 209A's battery option is installed.

RESPONSE

RESPONSE controls how the T-BERD 209A responds to loop codes (AUTO RESPONSE or NO RESPONSE). The RESULTS I display shows the current setting.

AUX	RESPONSE
RESPONSE	AUTO RESPONSE

When AUTO RESPONSE is enabled, the T-BERD 209A responds to loop codes by emulating a CSU. If five seconds of in-band loop-up codes are received, the T-BERD 209A

automatically enters Line Loopback (AUTO LLB) mode. The T-BERD 209A repeats (via transmitter) all data received until you send a valid loop-down code sequence. When sending a loop-down code, the T-BERD 209A exits AUTO LLB mode and reenters the previous mode, as specified by the setting of the MODE switch. Please note that AUTO LLB mode functions identically to T1 LLB mode.

NOTE: If AUTO RESPONSE is active and the T-BERD 209A is set to T1C, T1C TLB, or T1 LLB mode, the T-BERD 209A responds to the detection of a loop code by illuminating the LOOP UP or LOOP DOWN receive LEDs. AUTO LLB mode is not entered.

When NO RESPONSE is enabled, the T-BERD 209A remains in its current mode when detecting a loop code, but acknowledges the loop code's presence by illuminating the appropriate LED (LOOP UP or LOOP DOWN).

BAUD

BAUD sets the baud rate of the Printer/Remote Controller Interface. The lower RESULTS I display shows the current baud rate setting.

AUX BAUD RATE
BAUD 300 bps

Using the RESULTS I ⇕ switch, you can select baud rates of 300, 1200, 2400, and 4800.

GRAPH

GRAPH enables a graphic printing of the pulse shape when a printer with graphic capability is connected to the Printer/Remote Controller Interface.

AUX PRESS ARROW TO PRINT
GRAPH PULSE

You can initiate a pulse shape printout by pressing the RESULTS I ⇕ switch.

LP CODE

LP CODE determines the loop code pattern that is sent when the LOOP UP or LOOP DOWN switch is pressed. The lower RESULTS I display shows the current loop code setting.

AUX LOOP CODE
LP CODE CSU

CSU selects CSU loop code (loop-up code: 10000; loop-down code: 100); FAC1 selects facility loop code (loop-up code: 1100; loop-down code: 11100); PGM selects the user-programmed loop codes defined in the PGM LPUP and PGM LPDN auxiliary functions.

C. Indicators

2.09 The T-BERD 209A front panel features various discrete alarm and status indicators: green LEDs are used to indicate positive conditions; red LEDs are used to indicate alarm or failure conditions. Three groups of indicators are described below; the numbers preceding the descriptions correspond to the numbers in Figure 1.

(18) SIGNAL STATUS—These green indicators are illuminated for at least 100 ms to provide information about the status and type of signal being received. The following is a list of the signal status indicators and their functions.

(a) T1 PULSES—is illuminated when a signal with the correct T1 pulse width is detected at the T-BERD 209A's input connector.

(b) T1C PULSES—is illuminated when a signal with the correct T1C pulse width is detected at the T-BERD 209A's input connector.

(c) PATTERN SYNC—is illuminated when pattern synchronization is achieved. Synchronization to a fixed pattern (ALL ONES, 1:1, 1:7, 3 IN 24, and two user-programmable patterns) is declared when 30 consecutive error-free bits are received. Synchronization to a pseudorandom pattern is declared upon the reception of 30 + n consecutive error-free bits for a pattern length of 2^n-1 (for the QRSS patterns, n = 20). The PATTERN SYNC indicator is turned off when pattern synchronization is lost.

(d) FRAME SYNC—is illuminated when the T-BERD 209A acheives synchronization to the selected framing pattern within the T1 data stream. The selected framing pattern is based on the currently selected mode (i.e., T1 D4, T1 ESF, T1 SLC, T1 TLB, or T1 LLB). In T1 TLB and T1 LLB modes, the T-BERD 209A automatically determines the framing type and configures itself to accept either unframed data, D4-framed data, ESF-framed data, or SLC-framed data.

(e) B8ZS—is illuminated when B8ZS clear channel codes are detected in the received T1 or T1C signal.

NOTE: When B8ZS code is detected in instances where the CODE switch is in the AMI position, the message B8ZS DETECTED is displayed in the SUMMARY results category.

(19) ALARM Indicators—ALARM indicators are illuminated on the occurrence of specific alarm conditions. When such a condition occurs, the indicator remains illuminated for at least 100 ms. History indicators are also provided for each alarm condition; these indicators indicate the existence of an alarm condition during the test by

illuminating after an alarm condition has terminated. The following is a list of the alarm indicators and their functions.

(a) SIGNAL LOSS—is illuminated when no pulses are detected for 150 ms.

(b) PATTERN LOSS—is illuminated whenever 250 bit errors are counted in less than 1000 bits of data, thereby signaling a loss of pattern synchronization. A pattern loss condition terminates when pattern synchronization is reacquired.

(c) FRAME LOSS—is illuminated when 2 out of 5 Ft bits are detected in error for D4 or SLC-96 framing, or when 2 out of 5 framing bits are detected in error for ESF framing.

(d) ONES DENSITY—is illuminated when the received data contains less than 12.5% Ones. This indicator is lit when the pulse density criteria specified in AT&T Technical Reference PUB62411 or AT&T Compatibility Bulletin 119 is violated. Note that the 2^{15}-1, 2^{20}-1, 2^{23}-1, and 3-in-24 data patterns all cause this LED to illuminate.

(e) EXCESS ZEROS—is illuminated when 16 or more consecutive zeros are detected in T1 modes, or when 34 or more consecutive zeros are detected in T1C modes.

(f) YELLOW ALARM—is illuminated when bit 2 of each DS0 channel has been forced to a zero for D4 or SLC-96 framing, or when the yellow alarm pattern (0000000011111111) is detected in the 4 kb/s data link for ESF framing. This alarm condition applies to framed T1 signals only.

(g) ALL ONES—is illuminated when 2048 consecutive ones are detected for T1C or unframed T1 signals, or when 256 consecutive DS0 channels contain all ones for T1 framed modes.

(h) PULSE SHAPE—is illuminated when the pulse shape does not fit within the selected mask.

Pulse shape measurements are available only when the signal level is 0 dBdsx ± 4 dB for BRIDGE and TERM, or when the signal level is −20 dBdsx ± 4 dB for DSX-MON.

(i) LOW BATTERY—is illuminated approximately 15 minutes before the T-BERD 209A's battery is completely drained of power. The LOW BATTERY HISTORY LED illuminates when the LOW BATTERY LED indicator is illuminated and AC power is applied to the instrument.

(j) POWER LOSS—is illuminated when the T-BERD 209A is powered up, either after being manually turned off or after an accidental power loss. If a test is in progress at the time of a power loss, it is automatically restarted when power is regained. The indicator remains illuminated either until the HISTORY RESET switch is pressed or until a major switch change (e.g., MODE, PATTERN, etc.) causes a test restart.

(20) LOOP CODE—LOOP CODE indicators provide information about loop codes being received by the T-BERD 209A. The following is a list of the loop-code indicators and their functions.

(a) PRE-EXIST LOOP—is illuminated when an in-band loop-up code is detected within a period of 1.5 seconds from the start of loop-up code transmission. This indicator remains illuminated for 5 seconds. When a pre-existing loop is detected, the transmission of the in-band loop-up code is immediately halted.

(b) LOOP UP—is illuminated when an in-band loop-up code is received by the T-BERD 209A. The presence of a loop-up code can be detected when the error rate is 10^{-3} or less. It can also be detected with or without the presence of T1 framing.

(c) LOOP DOWN—is illuminated whenever an in-band loop-down code is received by the T-BERD 209A. Like loop-up code, the presence of a loop-down code can be detected when the error rate is 10^{-3} or less. It can also be detected with or without the presence of T1 framing.

D. Connectors

2.10 The T-BERD 209A features several connectors on its front panel; these connectors are described below. The numbers preceding the descriptions correspond to the numbers in Figure 1.

(21) DSX OUTPUTS - Three additional WECo 310 jacks provide DSX-level transmit outputs. Each output provides a 3-volt base-to-peak output into a 100-ohm load. Any or all 3 of these outputs can be used simultaneously; however, the transmit output connectors (22) should always be used first.

(22) TRANSMIT OUTPUT - Three primary transmit output connectors allow either a WECo 310 jack, a bantam jack, or a 15-pin D connector to be used to provide transmit output (after the signal has passed through a switchable line buildout circuit). The line buildout circuit (T1 only) inserts artificial line sections with either 7.5 or 15 dB of loss at 772 kHz or bypasses the artificial lines, presenting a DSX-level output. These connectors also provide the simplex current path to the receiver input jack. Note that only one of these output connectors should be used as the output source at a given time.

(23) NETWORK INTERFACE - This female, 15-pin D connector allows connection to the CSU or to the local loop. A 15-pin male-to-male cable is used to connect to the customer side of the CSU or to the local loop network interface connector. This connector is used in lieu of the TRANSMIT OUTPUTs and the RECEIVE INPUTs.

(24) T1 REF - T1 REF is WECo 310 and bantam input connectors that are used to input a T1 reference clock to the T-BERD 209A. This connector accepts resistively attenuated signals over the range +6 to -24 dBdsx, and is used in measuring timing slips and wander, as well as an external timing source.

(25) RECEIVE INPUTS - Three receive input connectors allow either a WECo 310 jack, a bantam jack, or a 15-pin D connector to be used to accept the receive input signal. The RECEIVE INPUT switch determines whether the input is either terminated into 100 ohms or is bridged, and whether Automatic Line Buildout (ALBO) or Automatic Gain Control (AGC) circuits are used to accommodate signals attenuated by either cable or resistive circuits. Note that only one of these connectors should be used as the receive input at a given time.

Measurements

2.11 The T-BERD 209A T-Carrier Analyzer performs a variety of measurements. These measurements are divided into six different categories:

(1) SUMMARY
(2) LOGIC
(3) BPV & FRAME
(4) SIGNAL
(5) TIME
(6) WANDER

2.12 These six categories and the results available in each are discussed in the following paragraphs.

A. SUMMARY Category

2.13 The SUMMARY category allows you to display key non-zero test results or test results that exceed specification boundaries without scrolling through the other results categories. The results that are available in the SUMMARY category are listed below, along with each result's category of origin:

(1) 00 BIT ERRORS (LOGIC)
(2) 09 SLIPS (LOGIC)
(3) 25 VIOLATIONS (BPV & FRAME)
(4) 30 FRM ERRORS (BPV & FRAME)
(5) 32 CRC ERRORS (BPV & FRAME)
(6) 34 FRM LOS CNT (BPV & FRAME)
(7) 40 RX FREQ Hz (SIGNAL)
(8) 44 PULSE SHAPE (SIGNAL)
(9) 51 TIMING SLIP (SIGNAL)

2.14 In addition to the test results shown above, the message B8ZS DETECT flags the presence of B8ZS code when the CODE switch is set to the AMI position.

2.15 When all summary results are error-free or meet specification boundaries (e.g., RX FREQ Hz and PULSE SHAPE), the message ALL RESULTS OK appears in the display.

2.16 The SUMMARY category is ideal when used in tandem with AUTO mode and status indicators to monitor live circuits.

B. LOGIC Category

2.17 The LOGIC category results (Table 1) are based on a bit error count (Result 00), updated each time bit errors are detected in the currently selected data pattern. When pattern synchronization is lost, the bit error count continues or halts based on the setting the HALT/CONT auxiliary function.

2.18 The slip count (Result 09) displays the total number of pattern slips since the beginning of the test. A pattern slip is detected if one or more bits are missing from or added to the expected pseudorandom bit sequence.

2.19 In addition to these results, a set of performance analysis results, such as severely errored seconds, available seconds, and degraded minutes, are included in the Performance Analysis Option (see Performance Analysis Option).

C. BPV & FRAME Category

2.20 The results in the BPV & FRAME category are designed for in-service monitoring of T-carrier spans. In this category, all test results evolve from bipolar violation (BPV) counts and frame error counts.

2.21 Available under the VIOLATIONS test result, the BPV count increases each time that successive T1 or T1C pulses of the same polarity are detected (except when part of a B8ZS substitution code). The BPV count is also the basis for calculating BPV seconds and BPV rate.

2.22 When counting frame errors, the T-BERD 209A analyzes the frame information embedded within a T1 signal. Frame errors detected in D1D, D2, D3, D4, SLC-96, or ESF framing signals are used as the basis for calculating framing error rate and frame losses. The T-BERD 209A also displays the number of frame synchronization losses, along with the number of seconds that frame synchronization was actually lost. For T1 circuits with ESF framing, the T-BERD 209A detects and accumulates CRC-6 errors which are used to calculate the CRC error rate and CRC errored seconds.

2.23 Table 2 briefly describes the test results that are available under the BPV & FRAME category.

Table 1—Logic Category Test Results

RESULT NUMBER	RESULT NAME	DESCRIPTION
00	BIT ERRORS	A count of received bits which have a value opposite that of the corresponding transmitted bits (Mark or Space) after pattern synchronization is achieved.
01	ASYNC ERR SEC	A count of test seconds where one or more bit errors occurred.
04	BIT ERR RT	The ratio of bit errors to received pattern data bits.
05	ER FREE SEC	A count of the seconds during which pattern synchronization is maintained through the entire second and no bit error occurred.
06	% EFS	The ratio, expressed as a percentage, of error-free seconds to the total number of seconds during which pattern synchronization is present.
07	SYN ERR SEC	A count of errored seconds synchronized to the occurrence of an error (the count and time interval begin with the occurrence of an error).
08	OUT SYN SEC	A count of the total number of seconds since the beginning of the test during which pattern synchronization was not maintained for the entire second.
09	SLIPS	A count of the total number of pattern slips since the beginning of the test.
10	SEV ERR SEC*	A count of seconds during which the bit error ratio was worse than 1×10^{-3} within available time.
11	%SEV ER SEC*	The ratio, expressed as a percentage, of severely errored seconds to the number of available seconds.
12	DEGR MIN*	A count of minutes during which the bit error ratio was worse than 1×10^{-6}.
13	%DEGR MIN*	The ratio, expressed as a percentage, of degraded minutes to the number of available minutes.
14	UNAVL SEC*	A count of unavailable time.
15	%AVLBILITY*	The ratio, expressed as a percentage, of available seconds to the number of test seconds.
16	CSES	A count of the number of groups of three or more contiguous seconds in which an error rate worse than 1×10^{-3} was found in each second.

*Available only with the Performance Analysis Option (see Appendix A).

Table 2—BPV & FRAME CATEGORY Test Results

RESULT NUMBER	DISPLAYED RESULT NAME	DESCRIPTION
25	VIOLATIONS	A count of BPVs detected since the start of the test (excluding intentional violations found within B8ZS codes).
26	BPV SECONDS	A count of the seconds within which one or more BPVs occurred.
27	BPV RATE	The ratio of BPVs to the number of data bits received.
28	FRM ERR SEC	A count of the seconds during which one or more frame errors occurred.
29	FRAME SES	A count of the seconds during which the TOTAL number of frame errors equaled 12 or more (D4 framing only).
30	FRM ERRORS	A count of the frame errors detected since the start of the test. For D4-compatible framing, frame errors are counted if either an Ft or an Fs frame bit is in error. For ESF framing, frame errors are counted on FPS bits.
31	FRM ER RATE	The ratio of frame errors to the number of analyzed framing bits.
32	CRC ERRORS	A count of CRC errors detected. CRC error are counted only when ESF framing is present in the received T1 data.
33	CRC ERR SEC	A count of seconds within which one or more CRC errors are detected.
34	FRM LOS CNT	A count of discrete losses of frame synchronization that occurred during the test.
35	FRM LOS SEC	A count of seconds since initial frame synchronization during which one or more frame synchronization losses occurred or during which frame synchronization could not be achieved.
36	CRC SES	A count of seconds during which the total number of CRC errors and frame synchronization losses equaled 320 or more.
37	CRC ERR RT	A count of CRC errors divided by the total number of ESF superframes analyzed.

D. SIGNAL Category

2.24 The SIGNAL category groups results that analyze the characteristics of the input signal.

2.25 Three types of receive level measurement are obtainable. The first measures peak voltage level and is expressed in dB relative to a standard 3-volt, base-to-peak signal (dsx level). This measurement is displayed in dBdsx (Result 41) and is valid for any T1 or T1C signal. The second measurement is displayed in dBm (Result 42) and may be performed only on an all-ones signal. The third measurement displays the signal level in peak-to-peak volts (Result 43).

2.26 This category also offers a series of pulse shape measurements that mark the width, rise time, fall time, overshoot, and undershoot of a T1 pulse. Additionally, timing slips and simplex current results are also available.

2.27 When measuring timing slips, the signal reference is taken from either the source attached to the BNC connector or from the T1 REF input on the front panel as follows:

BNC PRESENT?	T1 REF PRESENT?	THEN THE SIGNAL REFERENCE IS:
PRESENT	NOT PRESENT	BNC
NOT PRESENT	PRESENT	T1 REF
PRESENT	PRESENT	T1 REF
NOT PRESENT	NOT PRESENT	Not available

2.28 Table 3 briefly describes the test results that are available under the SIGNAL category.

Table 3—The SIGNAL Category Test Results

RESULT NUMBER	DISPLAYED RESULT NAME	DESCRIPTION
40	RX FREQ, Hz	The frequency of the clock recovered from the received data.
41	RX LEVEL dBdsx	The level of the received signal in dB relative to a standard 3-volt base-to-peak signal (DSX level).
42	RX LEVEL dBm	The power level of an all-ones signal (applicable only when all ones is detected).
43	RX LEVEL V p-p	The level of the received signal in peak-to-peak volts. The signal level is displayed as V or mV when it is higher or lower than 1 volt, respectively.
44	PULSE SHAPE	A PASS/FAIL result which shows whether the T1 pulse shape is within the boundary of the specified pulse mask.
45	PULSE WIDTH	The pulse width of a T1 pulse, displayed in nanoseconds. This measurement is not available in T1C mode.
46	RISE TIME	The time interval between the 10% and 90% points of the rising edge of the T1 pulse, displayed in nanoseconds. This measurement is not available in T1C mode.
47	FALL TIME	The time interval between the 10% and 90% points of the falling edge of the T1 pulse. This measurement is not available in T1C mode.
48	UNDERSHOOT	The level difference from the minimum point to the 0% point of the T1 pulse. UNDERSHOOT is displayed as a percent of the normalized pulse where the normalized pulse height equals 100%.
49	OVERSHOOT	The level difference from the maximum point to the 100% point of the T1 pulse. OVERSHOOT is displayed as a percent of the normalized pulse where the normalized pulse height equals 100%.
50	SPX CURRENT	The magnitude of the simplex current flowing between the Tx output tip and ring and the Rx input tip and ring.
51	TIMING SLIP	Timing slips are counted when the RECEIVER input has slipped +193 bit time periods from the T1-REF input. Single bit slips are displayed graphically next to timing slips.
53	SLP ANA SEC	A count of test seconds during which Timing Slip Analysis has been performed.

E. TIME Category

2.29 The TIME category offers time-related measurements such as signal loss seconds, test length, and time remaining in a test.

2.30 Table 4 briefly describes the test results that are available under the TIME category.

F. WANDER Category

2.31 The WANDER category tests for the presence of wander on the T1 signal. Six different test results identify and isolate network synchronization problems.

NOTE: Wander test results are available only for T1 signals, and require the presence of a T1 reference signal or an external clock source.

2.32 When measuring wander, the signal reference is taken from either the source attached to the BNC connector or from the T1 REF input on the front-panel as follows:

WHEN BNC TIMING IS:	AND T1 REF TIMING IS:	THE SIGNAL REFERENCE SOURCE IS:
PRESENT	NOT PRESENT	BNC
NOT PRESENT	PRESENT	T1 REF
PRESENT	PRESENT	T1 REF
NOT PRESENT	NOT PRESENT	Not available

Table 4—The TIME Category Test Results

RESULT NUMBER	DISPLAYED RESULT NAME	DESCRIPTION
60	SIG LOS SEC	A count of test seconds during which the signal was not present or during which one or more signal losses occurred.
61	ALARMED SEC	A count of test seconds during which a Yellow, All Ones, or Ones Density alarm was detected.
62	TEST LENGTH	The currently set test length for a timed test, in HHH:MM format.
63	ELAPSED TIME	The number of hours, minutes, and seconds (1) since a proper frequency and level has been detected or (2) since the last major switch change.
64	TEST END IN	Time remaining in a timed test, in HHH:MM:SS format.
65	CLOCK TIME	The time of day in HH:MM:SS format.
66	DATE	The date in DD:MM format.

2.33 Table 5 briefly describes the test results that are available under the WANDER category.

Side-Panel Power Switch and Connectors

2.34 The T-BERD 209A features a side-panel POWER switch and several connectors. The POWER switch and connectors are described in the following paragraphs.

A. POWER Switch

2.35 The POWER switch applies and removes power to the T-BERD 209A.

B. Connectors

2.36 A power receptacle and two connectors are featured on the T-BERD 209A's right side panel.

2.37 A 3-pin receptacle is provided for 115 VAC 50/60 Hz operation; the safety ground connection is wired directly to the chassis. The line fuse compartment is located directly above the 3-pin receptacle and contains a spare fuse.

WARNING: Ground the instrument. To minimize shock hazard, the instrument chassis must be connected to an electrical ground. The instrument is equipped with a three-conductor AC power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adaptor with grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet.

CAUTION: The T-BERD 209A should be operated with a 1A, 250V, SLO-BLO fuse installed (Littlefuse #218001 or equivalent.) Always use correct fuse size.

2.38 The BNC connector located on the side panel can be used to input an external clock source. This clock source

Table 5—The WANDER Category Test Results

RESULT NUMBER	DISPLAYED RESULT NAME	DESCRIPTION
70	WANDER +PK	The maximum positive peak wander deviation since the beginning of the test, defined in Unit Intervals (UIs).
71	WANDER −PK	The maximum negative peak wander deviation since the beginning of the test, defined in UIs.
72	P-P WANDER	The total deviation of positive-to-negative peak wander since the beginning of the test, defined in UIs.
73	15m WANDER	The maximum peak-to-peak wander deviation over the last 15 minutes of the test. This result is unavailable for the first 15 minutes of the test and is updated once per minute thereafter.
74	24h WANDER	The maximum peak-to-peak wander deviation over the last 24 hours of the test. This result is unavailable for the first 24 hours of the test and is updated once per hour thereafter.
75	TIE WANDER	Time Interval Error (TIE); the variation in time delay of a given timing signal with respect to the T1 reference signal or external clock source over the test interval. Valid range is +99999 UI.

can be selected and used to generate data when the front-panel TIMING switch is set to the EXT position. A reference clock for timing slips can also be input on this connector. This input is AC-coupled and has a 50-ohm input impedance.

2.39 The female 25-pin D connector serves as the RS-232 Printer/Remote Control Connector. It is configured with DCE pin-outs to connect the T-BERD 209A to a printer, terminal, or computer.

Pull-Out Reference Card

2.40 The T-BERD 209A features a pull-out card which furnishes quick reference information including: (1) a list of the available MODE and PATTERN selections; (2) a list of auxiliary functions with instructions on how they are set; and (3) a list of the available results, grouped by category and sorted by result number.

2.41 The card is stored below the front panel; to pull out the card, locate the semi-circular notch in the front center of the T-BERD's bottom panel and slide the card straight out. The card remains attached to the instrument but is hinged so that it may be folded down for better visibility when the instrument is resting on its back panel.

PREPARATION FOR USE

3.01 This section provides information on preparing the T-BERD 209A for use. Specifically included are instructions for unpacking and inspecting the instrument; a list of the equipment that should be contained in the shipment; and an instrument checkout procedure.

3.02 The procedures in this section assume that you possess a working knowledge of the T-BERD 209A. If you are unfamiliar with the instrument, please refer to Instrument Description.

Unpacking

3.03 The T-BERD 209A's shipping container should be inspected for damage when it is received. If the shipping container or shipping material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. Procedures for checking the electrical performance of the instrument are given in Instrument Checkout.

3.04 If the contents are incomplete, or if the T-BERD 209A does not pass the performance tests, notify TTC. If the shipping container is damaged, notify the carrier as well as TTC, and keep the shipping container and materials for the carrier's inspection.

Equipment Included

3.05 The following is a list of the equipment that should be present when the T-BERD 209A shipment is received and unpacked.

(1) T-BERD 209A T-Carrier Analyzer

(2) AC Line Cord

(3) Operating Manual

Instrument Checkout

A. Getting Started

3.06 Prior to performing the instrument checkout procedure, do the following:

(1) Remove the cover of the T-BERD 209A by unsnapping the metal latches on each side of the instrument. Turn the cover upside down and access the AC line cord compartment on the compartment panel and lifting the panel out of the cover.

(2) Insert the AC line cord into the AC receptacle on the T-BERD 209A's side panel and plug the other end of the cord into a 115 VAC power source.

WARNING: Ground the instrument. To minimize shock hazard, the instrument chassis must be connected to an electrical ground. The instrument is equipped with a three-conductor AC power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact-to-two-contact adaptor with grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet.

CAUTION: The T-BERD 209A should be operated with a 1A, 250V, SLO-BLO fuse (Littlefuse #218001 or equivalent). Always use correct fuse size. (See Section 6 for fuse replacement instructions).

B. Instrument Checkout Procedure

3.07 The T-BERD 209A should be checked mechanically and electrically upon unpacking. To verify proper electrical operation, perform these steps:

NOTE: To ensure that the proper results are selected during this procedure, the result names are followed by the result number in parentheses.

(1) Press the POWER switch to apply power to the T-BERD 209A.

(2) Using the MODE switch, set the operating mode to AUX. Ensure that these auxiliary functions are set as follows:

(a) HALT/CONT to HALT

(b) ERR SEL to SINGLE ERROR

(c) ER RATE to 1.0 E-6

(d) PLS MASK to DSX

(e) FRM ERROR to SINGLE ERROR

(3) Using the MODE switch, set the operating mode to self-test by scrolling through the available modes until SELF TST appears in the display. In self-test mode, the T-BERD 209A's transmitter is internally connected to its receiver; ESF framing and internal timing are automatically selected.

(4) Using the PATTERN switch, select the ALL ONES data pattern.

(5) Ensure that these LED indicators are illuminated:

(a) T1 PULSES

(b) PATTERN SYNC

(c) FRAME SYNC

(d) ALL ONES

(6) Set the RECEIVE INPUT switch to the TERM position and the TRANSMIT OUTPUT switch to the 0 dB position.

(7) Set the RESULTS I switch to the SIGNAL category, then use the ▲▼ switch to scroll the RX LEVEL (41) test result into the RESULTS I display. The value for this result should be 0 dBdsx ±0.5 dB.

(8) Set the TRANSMIT OUTPUT switch to −7.5 dB and confirm that the RX LEVEL result changes to −7.5 dBdsx ±1.5 dB.

(9) Set the TRANSMIT OUTPUT switch to −15 dB and confirm that the RX LEVEL result changes to −15 dBdsx +1.5 dB.

RESTART

(10) With the RESULTS I switch still in the SIGNAL position, scroll the RX FREQ (40) result into the RESULTS I display. Confirm that the value for this result is within the range 1543999–1544001 Hz.

(11) Set the RESULTS I switch to the SUMMARY position. The message ALL RESULTS OK should appear in the RESULTS I display.

(12) Press and release the FRAME ERROR INSERT switch several times to verify that the FRM ERRORS test result appears in the display and increments by one each time the switch is pressed.

(13) Press and release the BPV ERROR INSERT switch several times to verify that the VIOLATIONS test result appears in the display and increments by one each time the switch is pressed.

(14) Plug a bantam or WECo 310 patch cord into the front-panel transmit and receive connectors to loop the TRANSMIT output to the RECEIVE input.

(15) Using the MODE switch, select the T1C operating mode, then set the TIMING switch to the INT position.

(16) Press and release the LOGIC ERROR INSERT switch several times to verify that the BIT ERRORS test result appears in the display and increments by one each time the switch is pressed.

(17) Set the RESULTS I switch to the SIGNAL position, then scroll the RX FREQ (40) test result into the RESULTS I display. Confirm that the received frequency is within the range 3151968–3152032 Hz.

(18) Press and hold the LOGIC ERROR INSERT switch and the BPV ERROR INSERT switch until the LEDs within each switch are continuously illuminated.

RESTART

(19) Set the RESULTS I switch to the LOGIC position, then scroll the BIT ERR RT (04) test result into RESULTS I display. Set the RESULTS II switch to the BPV & FRAME position, then scroll the BPV RATE (27) test result into the RESULTS II display. After 10 seconds, both of the displays should show values within the range 9.0 E-07 to 1.1 E-06.

(20) If the Performance Analysis Option is installed in your T-BERD 209A, scroll to the LOGIC category to confirm that these test results are available:

(a) SEV ERR SEC (10)

(b) %SEV ER SEC (11)

(c) DEGR MIN (12)

(d) %DEGR MIN (13)

(e) UNAVL SEC (14)

(f) %AVLBILITY (15)

3.08 During the self-test, the T-BERD 209A's non-volatile RAM (NOVRAM) is checked because, at power-up, the T-BERD restores the instrument to the settings that were selected before the last power-down. If any changes are found, the factory settings are reloaded and the message RELOAD NOVRAM is displayed. The T-BERD 209A remains fully functional even though switch settings may not have been saved during the power cycle. While the instrument may be used, TTC should be called for service.

3.09 The instrument's RAM, EPROM, and microprocessor are also checked during the self-test. If any error is found, the messages BAD RAM, BAD ROM, or BAD PROCESSOR is displayed. In such instances, call TTC for service. There are no user-serviceable parts within the T-BERD 209A.

4. OPERATION

4.01 This section shows how the T-BERD 209A T-Carrier Analyzer is used in a variety of common test scenarios. Scenarios and instrument set-ups are provided for: (1) both in-service and out-of-service testing of T1, SLC-96, and T1C lines; (2) simplex current measurement and CSU emulation; (3) signal level measurement; and (4) pulse shape.

4.02 The procedures in this section assume that you possess a working knowledge of the T-BERD 209A. If you are unfamiliar with the instrument, please refer to Instrument Description.

T1 Testing

A. Error Analysis on a T-Carrier Circuit (Out-of-Service Loopback Test)

4.03 Figure 2 shows a T-BERD 209A connected to a DSX-1 patch panel. The instrument terminates the near-end of the T1 network, and transmits data to and receives data from the far-end CSU. The T-BERD 209A sends a loop-up code to the far-end CSU; the far-end CSU goes into loopback toward the T1 network and the T-BERD 209A. By analyzing the received data for errors, the T-BERD 209A analyzes the performance of the network up to and including the far-end CSU.

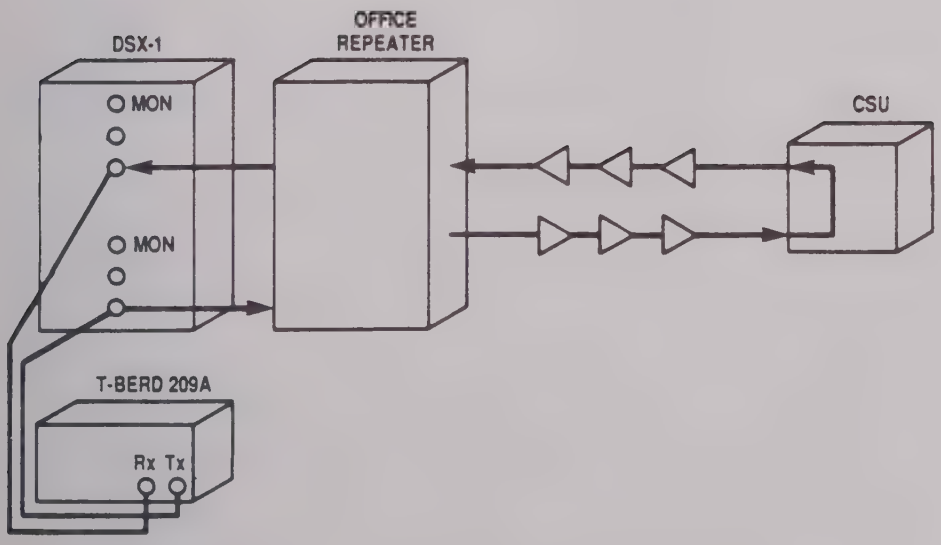

Figure 2—Testing a T1 Circuit in Loopback Mode

Basic T1 Out-of-Service Test Set-Up

4.04 To set up a basic out-of-service test of a T1 circuit, perform the steps shown in Table 6:

Table 6—Basic T1 Out-of-Service Test Set-Up

STEP:	ACTIVITY:
1.	Press the POWER switch to apply power to the T-BERD 209A.
2.	Set the MODE switch to the data format of the T-carrier circuit under test (T1, T1 D4, or T1 ESF framing).
3.	Set the PATTERN switch to the T1 QRSS position. **NOTE:** T1 QRSS is the standard test data pattern for T1 testing.
4.	Set the TIMING switch to the INT position to recover timing from the received data. **NOTE:** If testing is performed through a DCS, set the TIMING switch to the RECOVD position.
5.	Set the TEST switch to the CONT position.
6.	Set the CODE switch to either the B8ZS or AMI position, as appropriate.
7.	Ensure that all ERROR INSERT switches (FRAME, BPV, and LOGIC) are in the OFF position (i.e., switch LEDs should not be illuminated).
8.	Set the RECEIVE INPUT switch to the TERM position.
9.	Set the TRANSMIT OUTPUT switch to the 0dB(DSX) position.
10.	Using the LP CODE auxiliary function, select the desired loop-up code (CSU, FAC1, FAC2, or PGM).
11.	Connect your TRANSMIT and RECEIVE connectors to the circuit to be tested.
12.	Press the LOOP UP switch to send the selected loop-up code. **NOTE:** Deactivate the loop-up code at the conclusion of the test by pressing the LOOP DOWN switch.
13.	Verify that: a. The T1 PULSES LED indicator is illuminated. b. The PATTERN SYNC LED indicator is illuminated. c. The FRAME SYNC LED indicator is illuminated, if either the T1 D4 or T1 ESF mode is selected. d. The B8ZS LED indicator is illuminated, if clear channel (B8ZS) line coding is selected.
14.	Press the RESTART switch to begin the test.

Collecting T1 Out-of-Service Test Results

4.05 Immediately upon successfully configuring the T-BERD 209A for T1 out-of-service testing, follow the procedures shown in Table 7 to collect test results.

SUGGESTION: If errors are detected in Step 4, use a second T-BERD 209A to perform an end-to-end test on your T1 circuit. By configuring a second T-BERD 209A at the far end of the span, both sections of the span can be tested individually.

Table 7—Collecting T1 Out-of-Service Test Results

STEP:	ACTIVITY:
1.	Set the RESULTS I switch to the SUMMARY position. **RESULT:** These non-zero/out-of-spec results are displayed without scrolling: a. BIT ERRORS (LOGIC Category) b. SLIPS (LOGIC Category) c. VIOLATIONS (BPV & FRAME Category) d. FRM ERRORS (BPV & FRAME Category) e. CRC ERRORS (BPV & FRAME Category) f. FRM LOS CNT (BPV & FRAME Category) g. RX FREQ Hz (SIGNAL Category) h. PULSE SHAPE (SIGNAL Category) i. TIMING SLIP (SIGNAL Category)
2.	Using the ⇕ switch, scroll the RX LEVEL result into the RESULTS II display.
3.	Verify that the RX LEVEL is between −18 dBdsx and −22 dBdsx. (A 20 dB loss is incurred due to the isolation resistors in the monitor jacks; if the jacks are not isolated, the level will be between −2 dBdsx and +2 dBdsx.)
4.	Interpret test results as follows: **Interpreting Results:** a. If no errors are recorded for any of the SUMMARY test results, the message ALL RESULTS OK appears in the RESULTS I display; if no red alarm indicators are illuminated, the test is complete. In all other instances, use the ⇕ switch to scroll through the errored values. b. If BIT ERRORS and VIOLATIONS are detected, it is likely that the errors are being introduced at the near-end repeatered span. c. If BIT ERRORS are detected, but the VIOLATION count remains at 0, it is likely that the errors are not being introduced at the near-end span and further sectionalization is required. d. If the circuit under test is using a framed data format and SLIPS are displayed without FRM LOS CNT, then controlled slips are occurring. Controlled slips occur when multiplexers or DACS are used in a circuit with equipment that is not slaved (loop timed) to a common clock. e. If the circuit under test is using a framed data format and SLIPS are displayed with FRM LOS CNT, then uncontrolled slips are occurring.

B. Monitoring a Live T-Carrier Circuit (In-Service Testing)

4.06 Figure 3 shows a T-BERD 209A with its receive input connected to a monitor jack on a DSX-1 patch bay. Within the central office, the T1 signal passes through the DSX-1 patch bay and an office repeater before being transmitted on a repeatered span to the T1 network. In this configuration, the T-BERD 209A monitors the T1 signal for BPVs, frame errors, and signal impairments.

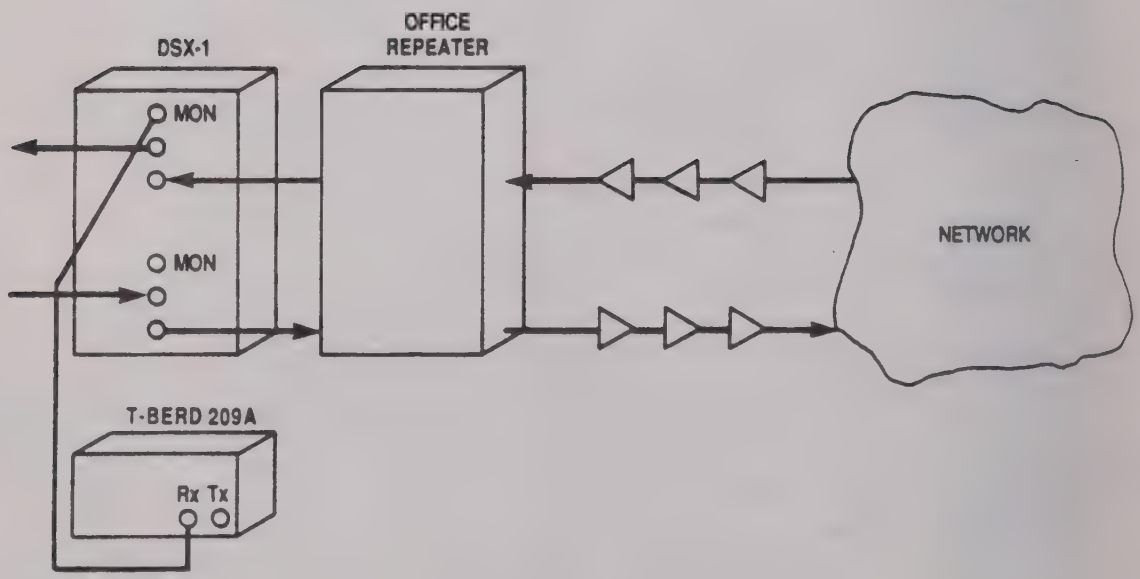

Figure 3–Monitoring a Live T1 Circuit

Performing an In-Service Test

4.07 To set up an in-service test of a T1 circuit, perform the steps shown in Table 8:

Table 8—Basic T1 In-Service Test Set-Up

STEP:	ACTIVITY:
1.	Press the POWER switch to apply power to the T-BERD 209A.
2.	Set the TEST switch to the CONT position.
3.	Set the RECEIVE INPUT switch to the DSX-MON position.
4.	Set the MODE switch to AUTO. **RESULT:** The T-BERD 209A automatically configures itself to the framing, coding, and data pattern on the live circuit.
5.	Connect the T-BERD 209A to the MON jack on the DSX patch bay (or CSU).
6.	Press the RESTART switch to begin the test. **Note the Following:** a. The T1 PULSES LED indicator is illuminated if a T1 signal is present. b. The FRAME SYNC LED indicator is illuminated if the signal contains T1 D4 or T1 ESF (Fe) framing. c. The name of the framing format appears in the MODE display in lower-case letters. d. The name of the received data pattern appears in the PATTERN display in lower-case letters. e. The B8ZS LED indicator is illuminated if the circuit is using clear channel (B8ZS) line coding.

Collecting T1 In-Service Test Results

4.08 Upon successfully setting up a T1 in-service test, follow the procedures shown in Table 9 to collect test results.

Table 9—Collecting T1 In-Service Test Results

STEP:	ACTIVITY:
1.	Set the RESULTS I switch to the SUMMARY position. **RESULT:** These non-zero/out-of-spec results are displayed with scrolling: a. BIT ERRORS* (LOGIC Category) b. SLIPS* (LOGIC Category) c. VIOLATIONS (BPV & FRAME Category) d. FRM ERRORS (BPV & FRAME Category) e. CRC ERRORS (BPV & FRAME Category) f. FRM LOS CNT (BPV & FRAME Category) g. RX FREQ Hz (SIGNAL Category) h. PULSE SHAPE (SIGNAL Category) i. TIMING SLIP (SIGNAL Category)
2.	Using the ⇕ switch, scroll the RX LEVEL result into the RESULTS II display.
3.	Verify that the RX LEVEL is between −18 dBdsx and −22 dBdsx. (A 20 dB loss is incurred due to the isolation resistors in the monitor jacks; if the jacks are not isolated, the level should be between −2 dBdsx and +2 dBdsx.)
4.	Interpret test results as follows: **Interpreting Results:** a. If no errors are recorded for any of the SUMMARY test results, the message ALL RESULTS OK appears in the RESULTS I display; if no red alarm indicators are illuminated, the test is complete. In all other instances, use the ⇕ switch to scroll through the errored values. b. If FRM ERRORS, CRC ERRORS, and VIOLATIONS are detected, it is likely that the errors are being introduced at the near-end repeatered span. c. If FRM ERRORS are detected, but the VIOLATION count remains at 0, it is likely that errors are not being introduced at the near-end repeatered span and further sectionalization is required.

*Not applicable for in-service testing

Simplex Current Measurement and CSU Emulation

4.09 Figure 4 shows a T-BERD 209A connected to a repeatered span. The instrument emulates the near-end CSU in transmitting data to and receiving data from the far-end. By initiating a manual loop at the DSX, data is returned to the T1 network and the T-BERD 209A. In this configuration, the T-BERD 209A analyzes the received signal to measure simplex current.

NOTE: One of the functions of the CSU is to complete the current path for powering the regenerative repeaters on the span. **HAZARDOUS VOLTAGES EXIST ON THE LINE SIDE OF THE CSU** and local telephone company office alarms may sound when the current path is interrupted. Since telephone companies do not have a uniform policy regarding the disconnection of the CSU from the span, **LOCAL TELEPHONE COMPANY INTERVENTION IS STRONGLY RECOMMENDED.** Advance notice should be given so that power can be removed from the span prior to disconnection of the CSU.

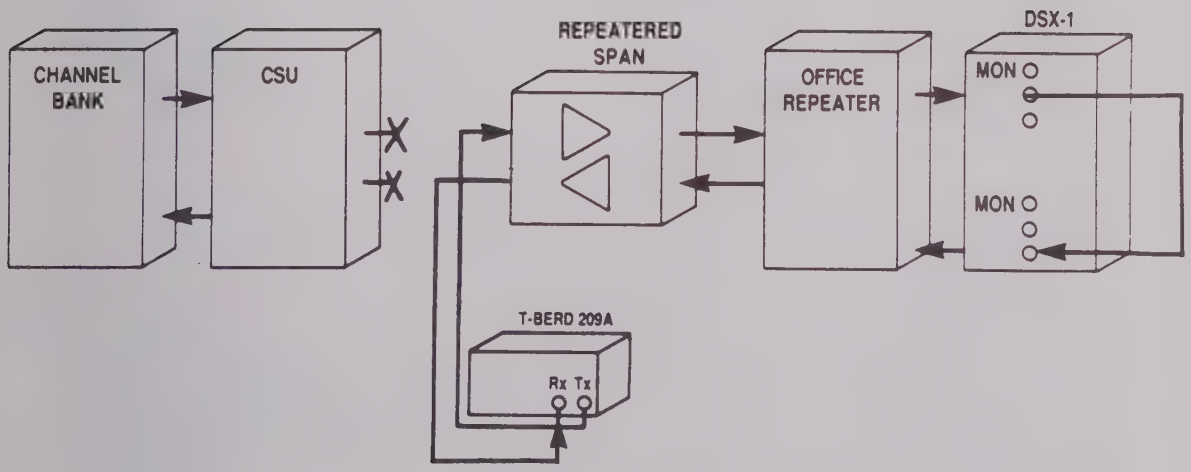

Figure 4—Simplex Current Measurement

A. Test Set-Up—Simplex Current Measurement/ CSU Emulation

4.10 To set up a test that measures simplex current, perform the steps shown in Table 10:

Table 10—Test Set-Up for Measuring Simplex Current

STEP:	ACTIVITY:
1.	Press the POWER switch to apply power to the T-BERD 209A.
2.	Set the MODE switch to the data format of the T-carrier circuit under test (T1, T1 D4, T1 SLC, or T1 ESF framing).
3.	Set the PATTERN switch to the T1 QRSS position. **NOTE:** T1 QRSS is the standard test data pattern for T1 testing.
4.	Set the TIMING switch to the INT position.
5.	Set the TEST switch to the CONT position.
6.	Set the CODE switch to either the B8ZS or AMI position, as appropriate.
7.	Ensure that all ERROR INSERT switches (FRAME, BPV, and LOGIC) are in the OFF position (i.e., switch LEDs should not be illuminated).
8.	Set the RECEIVE INPUT switch to the TERM position.
9.	Set the TRANSMIT OUTPUT switch to 0dB(DSX), -7.5 dB, or -15 dB, as appropriate. (To verify the correct setting, check the CSU the T-BERD 209A is replacing, or contact the local operating company.)
10.	Upon determining that power has been removed from the span line, disconnect the CSU from the span line. **DANGER: HIGH VOLTAGE MAY BE ENCOUNTERED.**
11.	Connect the span line to the T-BERD 209A using any of the following: a. A 15-pin D connector. b. A Model 10558 cable (if bare wires or spade lugs are supplied). c. A Model 10686 cable (if RJ45 connectors are supplied).
12.	Have the span line power restored.
13.	Press the RESTART switch to begin the test.
14.	Collect test results as shown in Table 4-6.

B. Collecting Simplex Current Test Results

4.11 Immediately upon successfully configuring the T-BERD 209A for simplex current measurement, follow the procedures shown in Table 11 to collect simplex current test results.

NOTE: An error analysis test can also be performed by following the steps described in Table 7 (Collecting T1 Out-of-Service Test Results).

Signal Level Measurement

4.12 The T-BERD 209A can measure input and output signal levels at any in-service CSU. To set up an in-service test for signal level measurement, perform the steps shown in Table 12.

Table 11—Collecting Simplex Current Test Results

STEP:	ACTIVITY:
1.	Set the RESULTS I switch to the SIGNAL position.
2.	Using the ⇕ switch, scroll the SPX CURRENT result into the RESULTS I display.
3.	Verify that the simplex current is correct. **Typical Values:** 60 mA and 140 mA.

Table 12—Signal Level Measurement Test Set-Up

STEP:	ACTIVITY:
1.	Press the POWER switch to apply power to the T-BERD 209A.
2.	Set the MODE switch to AUTO. **RESULT:** The T-BERD 209A automatically configures itself to the framing, coding, and data pattern on the live circuit.
3.	Set the RECEIVE INPUT switch to the BRIDGE position.
4.	Set the TEST switch to the CONT position.
5.	**DANGER: High voltage may be encountered.** Connect the T-BERD 209A RECEIVE INPUT to the receive line terminals (from the central office).
6.	Observe that the T1 PULSES LED is illuminated.
7.	Press the RESTART switch to begin the test.

A. Collecting Signal Level Test Results

4.13 Upon successfully setting up a test for measuring signal levels, follow the procedures shown in Table 13 to collect test results.

SLC-96 Testing

4.14 The T-BERD 209A can be used for either in-service monitoring or out-of-service testing of a T1 span used in a SLC-96 system.

Table 13—Collecting Signal Level Test Results

STEP:	ACTIVITY:
1.	Set the RESULTS I switch to the SIGNAL position.
2.	Using the switch, scroll the TX LEVEL result into the RESULTS I display.
3.	Verify that the RX level is between 0 dBdsx and -22 dBdsx, per AT&T Technical Reference PUB62411.
4.	**DANGER: High voltage may be encountered.** Connect the T-BERD 209A RECEIVE INPUT to the transmit line terminals (toward central office).
5.	Using the switch, scroll the TX LEVEL result into the RESULTS II display.
6.	Verify that the CSU line buildout (LBO) is properly set as follows: a. If the receive level is -15 dBdsx and below, the transmit level should be 0 dBdsx. b. If the receive level is -14 to -8 dBdsx, the transmit level should be -7.5 dBdsx. c. If the receive level is -7.5 dBdsx and above, the transmit level should be -15 dBdsx.

A. Basic SLC-96 Out-of-Service Test Set-Up

4.15 To set up a basic out-of-service test of a T1 span used in a SLC-96 system, perform the steps shown in Table 14:

Table 14—SLC-96 Out-of-Service Test Set-Up

STEP:	ACTIVITY:
1.	Determine if the protection spare T1 span is in use by examining the LEDs of each Line Interface Unit (LIU) for shelves A, B, C, and D. The LED labeled LINE ON PROT on the LIUs is illuminated when an error threshold in the corresponding T1 span is exceeded and the T1 span is placed out-of-service. This span should be tested and repaired prior to testing another span; otherwise, service may be interrupted. Note that if none of the LIUs are protected, then any of them can be tested.
2.	Install a pin plug into the pin jack labeled F END LP of the LIU to be tested.
3.	Connect an LIU Test Cord (a 15-pin D-to-edge connector cable) from the LIU to the JACK PANEL.
4.	Press the POWER switch to apply power to the T-BERD 209A.
5.	Set the MODE switch to the T1 SLC position.
6.	Set the PATTERN switch to the T1 QRSS position. **NOTE:** T1 QRSS is the standard test data pattern for T1 testing.
7.	Set the TEST switch to the CONT position.
8.	Set the TIMING switch to the INT position.
9.	Set the CODE switch to either the B8ZS or AMI position, as appropriate.
10.	Ensure that all ERROR INSERT switches (FRAME, BPV, and LOGIC) are in the OFF position (i.e., switch LEDs should not be illuminated).
11.	Set the RECEIVE INPUT switch to the TERM position.
12.	Set the TRANSMIT OUTPUT switch to the 0dB(DSX) position.
13.	Connect your TRANSMIT and RECEIVE connectors to JACK PANEL's RCVG LINE connector using WECo 310 cables. Verify that: a. The T1 PULSES LED indicator is illuminated. b. The PATTERN SYNC LED indicator is illuminated. c. The FRAME SYNC LED indicator is illuminated. d. The B8ZS LED indicator is illuminated, if clear channel (B8ZS) line coding is selected.

B. Collecting SLC-96 Test Results

4.16 Immediately upon successfully configuring the T-BERD 209A for SLC-96 out-of-service testing, follow the procedures shown in Table 15 to collect test results.

Table 15—Collecting SLC-96 Out-of-Service Test Results

STEP:	ACTIVITY:
1.	Set the RESULTS I switch to the SUMMARY position. **RESULT:** These non-zero/out-of-spec results are displayed without scrolling: a. BIT ERRORS (LOGIC Category) b. SLIPS (LOGIC Category) c. VIOLATIONS (BPV & FRAME Category) d. FRM ERRORS (BPV & FRAME Category) e. CRC ERRORS* (BPV & FRAME Category) f. FRM LOS CNT (BPV & FRAME Category) g. RX FREQ Hz (SIGNAL Category) h. PULSE SHAPE (SIGNAL Category) i. TIMING SLIP (SIGNAL Category)
2.	Using the ⇕ switch, scroll the RX LEVEL result into the RESULTS I display.
3.	Verify that the RX LEVEL is between -2 dBdsx and +2 dBdsx.
4.	Interpret test results as follows: **Interpreting Results:** a. If no errors are recorded for any of the SUMMARY test results, the message ALL RESULTS OK appears in the RESULTS I display; if no red alarms indicators are illuminated, the test is complete. In all other instances, use the ⇕ switch to scroll through the errored values. b. If VIOLATIONS and FRM ERRORS are detected, perform an end-to-end test using a second (similarly configured) T-BERD 209A configured at the far end of the span, either at the Central Office Terminal (COT) or the Remote Terminal (RT). To perform an end-to-end test, remove the pin plug from the F END LP position and insert it into the SW TO PROT position. A second T-BERD 209A can be configured at the far-end, permitting further sectionalization of the failure.

*Not available in SLC-96

C. Basic SLC-96 In-Service Test Set-Up

4.17 To set up a SLC-96 in-service test, perform the steps shown in Table 16:

Table 16—SLC-96 In-Service Test Set-Up

STEP:	ACTIVITY:
1.	Press the POWER switch to apply power to the T-BERD 209A.
2.	Set the MODE switch to AUTO. **RESULT:** The T-BERD 209A automatically configures itself to the framing (T1 SLC), coding, and data pattern on the live circuit.
3.	Set the TEST switch to the CONT position.
4.	Set the RECEIVE INPUT switch to the DSX-MON position.
5.	Connect the LIU Test Cord (a 15-pin D-to-edge connector cable) from the LIU to the JACK PANEL.
6.	Connect the T-BERD 209A to the RCVG MONITOR jack of the JACK PANEL.
7.	Press the RESTART switch to begin the test. **Note the Following:** a. The T1 PULSES LED indicator is illuminated if a T1 signal is present. b. The FRAME SYNC LED indicator is illuminated when SLC-96 framing is present. c. The name of the received data pattern appears in the PATTERN display (in lower-case letters). d. The B8ZS LED indicator is illuminated if the circuit is using clear channel (B8ZS) line coding.

D. Collecting SLC-96 In-Service Test Results

4.18 Upon successfully setting up a SLC-96 in-service test, follow the procedures shown in Table 17 to collect test results.

NOTE: The data transmitted by the LIU can be monitored by plugging the T-BERD 209A into the TRMTG MONITOR JACK and repeating steps 1-4.

Table 17—Collecting SLC-96 In-Service Test Results

STEP:	ACTIVITY:
1.	Set the RESULTS I switch to the SUMMARY position. **RESULT:** These non-zero/out-of-spec results are displayed without scrolling: a. BIT ERRORS* (LOGIC Category) b. SLIPS* (LOGIC Category) c. VIOLATIONS (BPV & FRAME Category) d. FRM ERRORS (BPV & FRAME Category) e. CRC ERRORS** (BPV & FRAME Category) f. FRM LOS CNT (BPV & FRAME Category) g. RX FREQ Hz (SIGNAL Category) h. PULSE SHAPE (SIGNAL Category) i. TIMING SLIP (SIGNAL Category)
2.	Using the ⇕ switch, scroll the RX LEVEL result into the RESULTS II display.
3.	Verify that the RX LEVEL is between -2 dBdsx and +2 dBdsx.
4.	Interpret test results as follows: a. If no errors are recorded for any of the SUMMARY test results, the message ALL RESULTS OK appears in the RESULTS I display; if no red alarms indicators are illuminated, the test is complete. In all other instances, use the ⇕ switch to scroll through the errored values. b. If FRM ERRORS and VIOLATIONS are detected, it is likely that the errors are being introduced at the near-end repeatered span. c. If FRM ERRORS are detected, but the VIOLATION count remains at 0, it is likely that errors are not being introduced at the near-end repeatered span.

*Not applicable for in-service testing
**Not applicable for SLC-96 testing

T1C Testing

A. Basic T1C Out-of-Service Test Set-Up

4.19 To set up an out-of-service test of a T1C circuit, perform the steps shown in Table 18:

Table 18—T1C Out-of-Service Test Set-Up

STEP:	ACTIVITY:
1.	Press the POWER switch to apply power to the T-BERD 209A.
2.	Set the MODE switch to the TIC position.
3.	Set the PATTERN switch to the 2^{20}-1 or T1C QRSS position. **NOTE:** TIC QRSS is the standard pattern for T1C testing.
4.	Set the TIMING switch to the RECOVD position to recover timing from the received data. **NOTE:** If loop timing is not required, set the TIMING switch to the INT position.
5.	Set the TEST switch to the CONT position.
6.	Set the CODE switch to either the B8ZS or AMI position, as appropriate.
7.	Ensure that all ERROR INSERT switches (FRAME, BPV, and LOGIC) are in the OFF position (i.e., switch LEDs should not be illuminated).
8.	Set the RECEIVE INPUT switch to the TERM position.
9.	Connect your TRANSMIT and RECEIVE connectors to the circuit to be tested.
10.	Verify that: a. The T1C PULSES LED indicator is illuminated. b. The PATTERN SYNC LED indicator is illuminated. c. The B8ZS LED indicator is illuminated, if clear channel (B8ZS) line coding is selected.
11.	Press the RESTART switch to begin the test.

B. Collecting T1C Out-of-Service Test Results

4.20 Immediately upon successfully configuring the T-BERD 209A for T1C out-of-service testing, follow the procedures shown in Table 19 to collect test results.

SUGGESTION: If errors are detected in Step 4, use a second T-BERD 209A to perform an end-to-end test on your T1C circuit. By configuring a second T-BERD 209A at the far end of the span, the two test instruments can exchange data and allow further problem isolation.

Table 19—Collecting T1C Out-of-Service Test Results

STEP:	ACTIVITY:
1.	Set the RESULTS I switch to the SUMMARY position. **RESULT:** These non-zero/out-of-spec results are displayed without scrolling: a. BIT ERRORS (LOGIC Category) b. SLIPS (LOGIC Category) c. VIOLATIONS (BPV & FRAME Category) d. RX FREQ Hz (SIGNAL Category)
2.	Using the ⇳ switch, scroll the RX LEVEL result into the RESULTS II display.
3.	Verify that the RX LEVEL is between −18 dBdsx and −22 dBdsx. (A 20 dB loss is incurred due to the isolation resistors in the monitor jacks; if the jacks are not isolated, the level will be between −2 dBdsx and +2 dBdsx.)
4.	Interpret test results as follows: **Interpreting Results:** a. If no errors are recorded for any of the SUMMARY test results, the message ALL RESULTS OK appears in the RESULTS I display; if no red alarms indicators are illuminated, the test is complete. In all other instances, use the ⇳ switch to scroll through the errored values. b. If BIT ERRORS and VIOLATIONS are detected, it is likely that the errors are being introduced at the near-end repeatered span. c. If BIT ERRORS are detected, but the VIOLATION count remains at 0, it is likely that errors are not being introduced at the near-end repeatered span.

C. Performing an In-Service Test

4.21 To monitor a T1C circuit at a DSX patch bay without disrupting the T1C service, perform the steps shown in Table 20:

D. Collecting T1C In-Service Test Results

4.22 Upon successfully setting up a T1C in-service test, follow the procedures shown in Table 21 to collect test results.

Table 20—T1C In-Service Test Set-Up

STEP:	ACTIVITY:
1.	Press the POWER switch to apply power to the T-BERD 209A.
2.	Set the TEST switch to the CONT position.
3.	Set the RECEIVE INPUT switch to the DSX-MON position.
4.	Set the MODE switch to AUTO. **RESULT:** The T-BERD 209A automatically configures itself to the rate, coding, and data pattern on the live circuit.
5.	Connect the T-BERD 209A to the MON jack on the DSX patch bay (or CSU).
6.	Press the RESTART switch to begin the test. **Note the Following:** a. The T1C PULSES LED indicator is illuminated if a T1 signal is present. b. The name of the received data pattern appears in the PATTERN display (in lower-case letters). c. The B8ZS LED indicator is illuminated if the circuit is using clear channel (B8ZS) line coding.

Table 21—Collecting T1C In-Service Test Results

STEP:	ACTIVITY:
1.	See the RESULTS I switch to the SUMMARY position. **RESULT:** These non-zero/out-of-spec results are displayed without scrolling. a. VIOLATIONS (BPV & FRAME Category) b. RX FREQ Hz (SIGNAL Category)
2.	Using the ⇕ switch, scroll the RX LEVEL result into the RESULTS II display.
3.	Verify that the RX LEVEL is between −18 dBdsx and −22 dBdsx. (A 20 dB loss is incurred due to the isolation resistors in the monitor jacks; if the jacks are not isolated, the level will be between −2 dBdsx and +2 dBdsx.)
4.	Interpret test results as follows: **Interpreting Results:** a. If no errors are recorded for any of the SUMMARY test results, the message ALL RESULTS OK appears in the RESULTS I display; if no red alarms indicators are illuminated, the test is complete. In all other instances, use the ⇕ switch to scroll through the errored values. b. If VIOLATIONS are detected, it is likely that the errors are being introduced at the near-end repeatered span.

Measuring Timing Slips and Wander

A. Timing Slips

4.23 The T-BERD 209A's timing slips measurement identifies frequency deviations which cause uncontrolled clock slips.

4.24 When measuring timing slips, the received T1 signal is compared with a reference signal connected to the T1 REF input (using a WECo 310 or bantam cable); this comparison allows the T-BERD 209A to count the number of times that the edges of the received signal move past the edges of the reference signal (Figure 5).

4.25 The TIMING SLIP result is displayed in three portions (Figure 6):

(1) a numeric value

(2) a bar graph

(3) a moving "wheel"

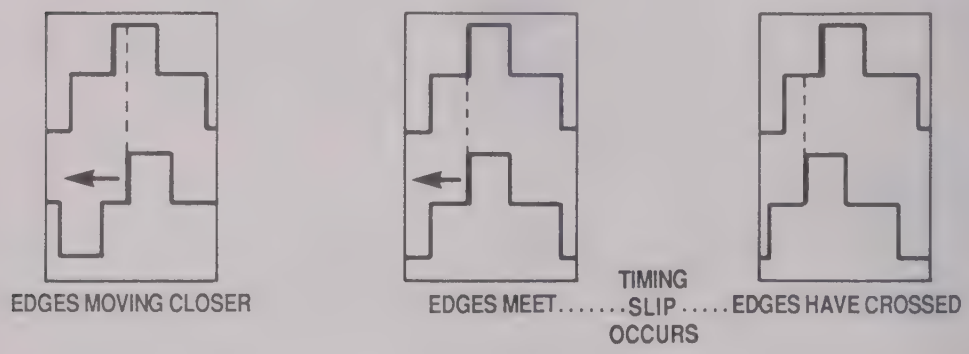

Figure 5—Timing Slips

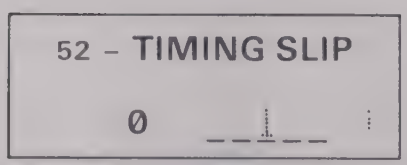

FIGURE 6—Timing Slips Results Display

4.26 The numeric value (range 0 to 9999) represents the total number of frame slips (1 frame slip = 193-bit slips). The bar graph represents partial frame slips in increments of one bar per 16 bit slips (one wheel rotation); each time the bar moves to the end of the graph, it is reset to the middle position and the frame slip count is incremented. The wheel is used in conjunction with the bar graph to graphically display the direction, rate, and magnitude of timing slips. Figure 7 shows the values assigned to each position of the bar graph and the wheel.

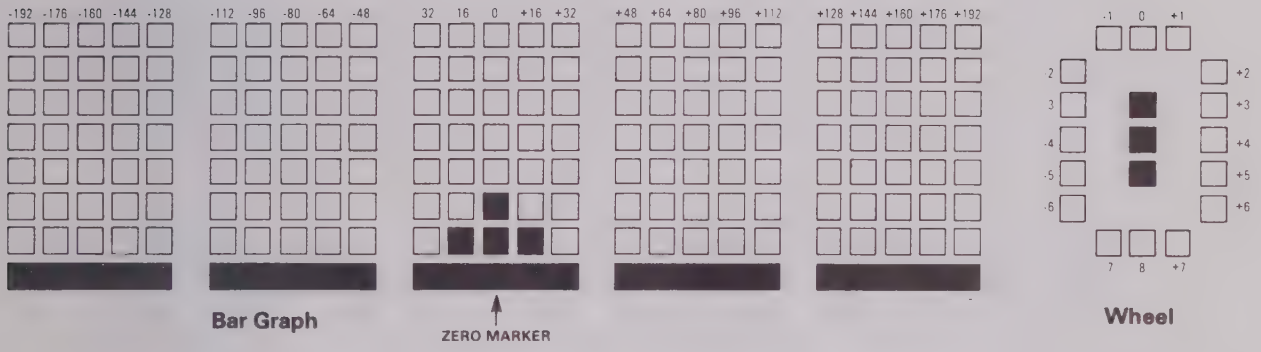

Figure 7—Bar Graph and Wheel Values

B. Determining the Magnitude of a Timing Slip

4.27 The magnitude of a timing slip is determined by adding the magnitude of the number indicated by the wheel's position to the corresponding bar graph value. For example, if the display shows:

the bar graph value is +96 and the wheel value is +3; adding these two values results in a timing slip of +99 bits (that is, 99 more clock cycles have been received at the RECEIVE input than at the T1 REF input, or the RECEIVE input is receiving a higher frequency than the T1 REF input).

If the display shows:

bar graph value is -160 and the wheel value is +6, the result is a timing slip of -154 bits.

C. Timing Slip Test Set-Up

4.28 To test for the presence of timing slips, perform the steps shown in Table 22.

Table 22—Timing Slips Test Set-Up

STEP:	ACTIVITY:
1.	Press the POWER switch to apply power to the T-BERD 209A.
2.	Using a WECo 310 or bantam cable, connect the T1 timing reference to the T1 REF front-panel input. **NOTE:** The T1 REF input accepts full DSX signals or DSX-MON point signals.
3.	Set the RECEIVE INPUT switch to the appropriate line termination position.
4.	Connect the RECEIVER INPUT to the line under test.
5.	Set the MODE switch to the appropriate T1 format.
6.	Set the RESULTS I switch to the SIGNAL position, then scroll the TIMING SLIP result into the RESULTS I display.
7.	Set the RESULTS II switch to the SIGNAL position, then scroll the SLIP ANA SEC result into the RESULTS II display.
8.	Press the RESTART switch to begin the test. **RESULT:** The SLP ANA SEC result should accumulate if both the T1 REF and RECEIVER signals are present. This result will not accumulate when either input is lost.

D. Analyzing Timing Slip Test Results

4.29 Timing slip results vary according to the timing relationship between the T1 REF and RECEIVER signals.

IF:	THEN:
The T1 REF and RECEIVER signals are perfectly synchronized	The timing slip count remains at 0, the bar graph remains at center, and the wheel remains at top-center.
The T1 REF and RECEIVER signals are synchronized, but one of the signals exhibits low-speed wander (e.g., Doppler shifts from satellites)	The timing slip count remains at 0; both the bar graph and the wheel move to the right as the satellite nears, and to the left as the satellite moves further away. Note that the +PK, −PK, and PK-PK wander results record the maximum deviation due to satellite Doppler shifts.
The T1 REF and RECEIVER signals are unsynchronized, and the RECEIVER frequency is higher than the T1 REF frequency	The wheel moves clockwise, the bar graph moves to the right, and the timing slip count increments every 193 bit slips. When the frequency difference is more than a few cycles, the TIMING SLIP count, bar graph, and wheel move very rapidly.
The T1 REF and RECEIVER signals are unsynchronized, and the RECEIVER frequency is lower than the T1 REF frequency	The wheel moves counter-clockwise, the bar graph moves to the left, and the timing slip count increments every 193 bit slips. When the frequency difference is more than a few cycles, the TIMING SLIP count, bar graph, and wheel move very rapidly.

E. Wander

4.30 The T-BERD 209A's wander measurements identify the deviations in time between when pulse transitions ideally occur and when digital decoding gear expect them to

occur. Wander is basically a slow form of jitter, occurring at frequencies less than 10 Hz; jitter time displacement occurs at rates greater than 10 Hz.

4.31 If the received bit stream is impaired by wander, the receive frequency is different from that of the transmit frequency. As a result of such frequency differences, the terminal clocks in more bits or fewer bits than it can clock out.

4.32 Terminal devices typically compensate for the presence of wander with buffers that store additional bits. As long as wander does not occur in the same direction for an extended period of time, these buffers can compensate for wander's presence. But if wander exceeds the buffer length, the buffer overflows or underflows and data is lost or disrupted.

Measuring Wander

4.33 Wander and timing slips are measured the same way — the received T1 signal is compared to a reference signal connected to the T1 REF input (using a WECo 310 cable). Wander is measured in UIs; 1 UI is equivalent to a single T1 time slot or one bit space in a buffer.

4.34 When measuring wander, the primary goal is to ensure that the amount of wander on the T1 signal is not exceeding an amplitude for which terminal buffers cannot compensate. The six wander measurements that are available with the T-BERD 209A are:

(1) **WANDER +PK** indicates the maximum positive peak wander deviation since the beginning of the test, expressed in UIs.

(2) **WANDER −PK** indicates the maximum negative peak wander deviation since the beginning of the test, expressed in UIs.

(3) **P-P WANDER** displays the total of the WANDER +PK and WANDER −PK measurements since the beginning of the test. The maximum amount of peak-to-peak wander that can be tolerated without buffer overflow is equal to buffer length.

(4) **15m WANDER** measures the maximum peak-to-peak wander deviation over the last 15 minutes of the test. Note that this result is unavailable for the first 15 minutes of the test and is updated once per minute thereafter.

(5) **24h WANDER** measures the maximum peak-to-peak wander deviation over the last 24 hours of the test. Note that this result is unavailable for the first 24 hours of the test and is updated once per hour thereafter.

(6) **TIE WANDER** measures the instantaneous displacement of the received T1 signal from the reference since the beginning of the test. This result can be positive or negative and is measured in UIs.

F. Wander Test Set-Up

4.35 To test for the presence of wander, perform the steps shown in Table 23.

Measuring Pulse Shape

4.36 Pulse shape measures the characteristics of a DS1 pulse waveform. In order to design equipment which can optimally receive a DS1 signal, constraints are placed on the shape of the signal that can be transmitted by DS1 equipment. This constraint is referred to as the *pulse mask*.

4.37 A pulse mask is a graphical representation of the restrictions which are placed on the pulse's output. Figure 8 depicts a sample T-BERD 209A pulse mask.

4.38 You can use the T-BERD 209A to determine if a DS1 pulse is within specification by comparing the pulse shape to a specification mask like the one shown in Figure 8. The T-BERD 209A is equipped with two such masks, both of which are selectable via the PLS MASK auxiliary function:

(1) **DSX** selects the pulse mask conforming to AT&T Compatibility Bulletin 119.

(2) **NET INTERFACE** selects the pulse mask conforming to the proposed ANSI T1.C1-NI specification.

4.39 If desired, you can evaluate a DS1 pulse without comparing it to a mask by setting the PLS MASK auxiliary function to NONE.

4.40 The T-BERD 209A is also equipped to output the pulse shape and mask to a graphics printer. Note that when NONE (no pulse mask) is specified, no mask appears on the pulse shape printout.

Table 23—Wander Test Set-Up

STEP:	ACTIVITY:
1.	Press the POWER switch to apply power to the T-BERD 209A.
2.	Using a WECo 310 or bantam cable, connect the T1 timing reference to the T1 REF front-panel input. **NOTE:** The T1 REF input accepts full DSX signals or DSX-MON point signals.
3.	Set the RECEIVE INPUT switch to the appropriate line termination position.
4.	Connect the RECEIVER INPUT to the line under test.
5.	Set the MODE switch to the appropriate T1 format.
6.	Set the RESULTS I switch to the WANDER position, then scroll the P-P WANDER result into the RESULTS I display.
7.	Set the RESULTS II switch to the WANDER position, then scroll the TIE WANDER result into the RESULTS II display.
8.	Press the RESTART switch to begin the test.

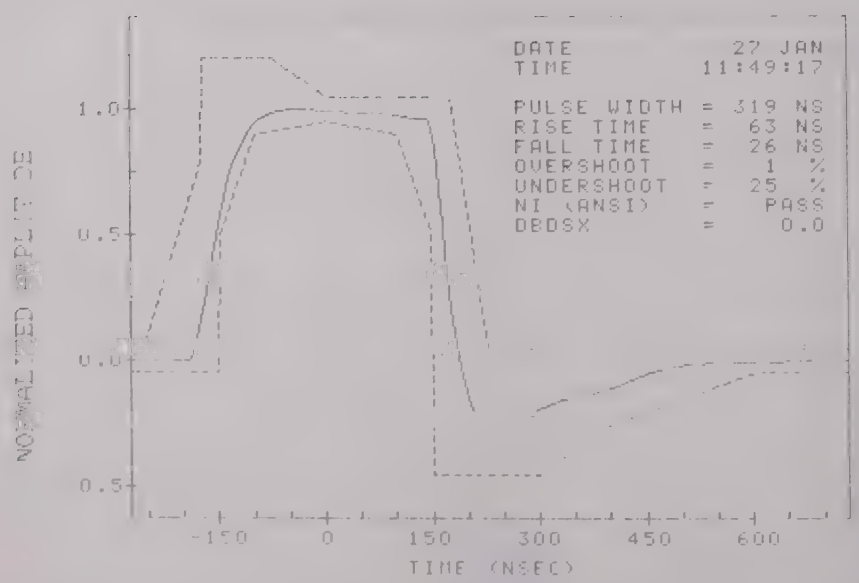

Figure 8—Sample Pulse Shape

A. Pulse Shape Test Set-Up

4.41 To analyze a DS1 pulse shape, perform the steps shown in Table 24. Note that these procedures assume that the test is being conducted at a DSX-1 cross-connect.

B. Collecting Pulse Shape Test Results

4.42 Immediately upon successfully configuring the T-BERD 209A for pulse shape testing, follow the procedures shown in Table 25 to collect test results.

Table 24—Pulse Shape Test Set-Up

STEP:	ACTIVITY:
1.	Press the POWER switch to apply power to the T-BERD 209A.
2.	Set the MODE switch to the AUX position.
3.	Using the PATTERN switch, scroll the PLS MASK auxiliary function into the RESULTS I display.
4.	Using the RESULTS I switch, set the PLS MASK auxiliary function to DSX (CB119).
5.	Returning to the PATTERN switch, select AUTO mode to automatically condition the receiver for the proper data format and data pattern (if present). **RESULT:** The name of the automatically selected mode and pattern appear in the RESULTS display in lower-case letters.
6.	a. Set the RECEIVE INPUT switch to the DSX-MON position if the line connection is made at a resistor-isolated monitor jack at the DSX patch bay. b. Set the RECEIVE INPUT switch to the BRIDGE position if the line connection is made at non-resistor-isolated monitor jacks at the DSX patch bay or demarcation point where jacks are unavailable.
7.	Connect the T-BERD 209A using the appropriate cables.
8.	Press the RESTART switch to begin the test.

Table 25—Collecting Pulse Shape Test Results

STEP:	ACTIVITY:
1.	Set the RESULTS I switch to the SUMMARY position.
2.	Interpret test results as follows: **Interpreting Results:** a. If PULSE SHAPE FAIL does not appear in the display and the PULSE SHAPE alarm LED is not illuminated, the DS1 pulse meets the DSX specification mask; the test is complete. b. If PULSE SHAPE FAIL appears in the display and the PULSE SHAPE alarm LED is illuminated, the DS1 pulse does not meet the DSX specification mask. In such instances, set the RESULTS I switch to the SIGNAL category and collect these key pulse shape measurements: (1) PULSE WIDTH (45) (2) RISE TIME (46) (3) FALL TIME (47) (4) UNDERSHOOT (48) (5) OVERSHOOT (49)

5. PRINTER/REMOTE CONTROL INTERFACE

5.01 This section describes the RS-232 Printer/Remote Control Interface.

The RS-232 Printer/Remote Control Interface

5.02 The RS-232 Printer/Remote Control Interface enables you to:

(1) Obtain hard-copy printouts of pulse shape graphs, test results, alarm messages, and front-panel set-ups.

(2) Remotely control the T-BERD 209A from a terminal or computer.

5.03 The RS-232 connector is configured to function as Data Communications Equipment (DCE); it may be directly connected to Data Terminal Equipment (DTE). Connection to other DCE is possible with the use of an adaptor cable. This RS-232 connector is a 25-pin female D connector located on the T-BERD 209A's right side-panel. Auxiliary functions are used to select the baud rate, parity, and line terminator.

5.04 Table 26 shows the selections available for configuring the RS-232 connector.

Table 26—RS-232 Printer/Controller Interface Configurations

Baud rate:	300, 1200, 2400, 4800
Word length:	7 bits, 8 bits
Parity:	Even, odd, none
Line terminator:	CR, CRLF
Column length:	80 characters

RS-232 Pin Configuration

5.05 To provide maximum operating flexibility, the use of the RS-232 signaling leads has been minimized. The interface monitors the Data Terminal Ready (DTR) line of the device to which it is connected. When this line is set true by the device, the T-BERD 209A assumes that the device is ready to accept a byte of data. The T-BERD asserts Clear To Send (CTS) true whenever it is ready to accept a byte of data from an external controller. Table 27 shows the RS-232 pin configuration.

Table 27—RS-232 Pin Configuration

PROT GND (Pin 1):	Connected to chassis ground.
TX DATA (Pin 2):	The T-BERD 209A receives data on this lead.
RCV DATA (Pin 3):	Data is transmitted by the T-BERD 209A on this lead.
RTS (Pin 4):	This lead is terminated by the T-BERD 209A.
CTS (Pin 5):	This lead is driven to the ON state by the T-BERD 209A whenever it is ready to receive a command. This lead may be ignored by the controller if, before issuing commands, it waits for the return of a prompt character from the T-BERD signifying the completion of the previous command.
DSR (Pin 6):	This lead is driven to the ON state by the T-BERD 209A whenever it has power applied.
SIGNAL GROUND (Pin 7):	Connected to signal ground.
RLSD (Pin 8):	Must be ON before the T-BERD 209A will accept any data.
SEC CTS (Pin 9) and SEC RCV DATA (Pin 10)	These leads provide +12 (RS-232 ON) and -12 (RS-232 OFF) respectively, for use in strapping signaling leads ON and OFF.
DTR (Pin 20):	Data is only output from the T-BERD 209A when this line is held in the ON condition by the receiving device.

Printer Operation

5.06 Printer operation is controlled by the PRINT and PRINT EVENT switches on the T-BERD 209's front panel.

5.07 The PRINT switch has two positions which specify the type of printout to be generated: RESULTS and CONTROLS. Results prints are hard-copy listings of current test results. Controls prints are hard-copy listings of the T-BERD 209A's current switch settings. When pressed, the PRINT switch generates the desired printout immediately. Results printouts and controls printouts are fully described in Section A. Results Print, respectively.

5.08 The PRINT EVENT switch is a six-position electronic switch with up (▲) and down (▼) arrows. LED indicators adjacent to the switch labels illuminate to reflect the current position of the switch. The switch positions and their functions are as follows:

OFF — Sends no data to the RS-232 connector and clears the printer buffer. Note that results and controls prints are still available using the PRINT switch.

2 HR—Initiates a results printout every two hours or if an alarm condition changes. (See Alarm Messages.)

15 MIN—Initiates a results printout every 15 minutes or if an alarm condition changes.

TEST END—Initiates a results printout at the end of a timed test or if an alarm condition changes.

ERROR—Initiates a results printout for each second on the occurrence of logical bit errors, CRC errors, frame errors, or bipolar violations, as well as if an alarm condition changes.

SEV ERR SEC—Initiates a results printout whenever the error rate exceeds 1×10^{-3} per second or if an alarm condition changes.

5.09 When the setting of the PRINT EVENT switch is changed to the OFF position, all printer buffers are cleared; any previously stored test results or messages are not printed.

NOTE: A 6-hour backup print is provided for both the ERROR and SEVERELY ERRORED SEC positions. The printout is labeled BACKUP PRINT and occurs only if the print criterion has not been satisfied for 6 hours.

5.10 A printer or terminal can be connected to the RS-232 Printer/Remote Control interface. Each result or control message is 20 characters long, and all printouts are date- and time-stamped.

A. Results Print

5.11 Results prints are hard-copy listings of current test results. Using the PRNT FMT auxiliary function, you can select normal, short, or summary results print formats.

5.12 The normal format includes all results available at the time the printout is initiated.

5.13 The short format consists only of the results applicable to the current setting of the MODE switch, and the two test results currently displayed on the front panel (even if they are not applicable to the current setting of the MODE switch).

5.14 The summary format provides a printout of all test results in the SUMMARY category.

5.15 All three types of results prints also list any alarm LEDs that are illuminated at the time the printout is initiated. Figure 9 is an example of a normal results printout.

5.16 The results that are printed in the short form for each mode are as follows:

All Modes	D4 and SLC Framing	ESF
TIME and DATE	FRM ERR	CRC ERR
BPV	FRM ER RT	CRC ERR SEC
BPV SEC	FRM L CNT	FRM L CNT
BPV RT	FRM L SEC	FRM L SEC
SIG L SEC	TEST LEN	
ALARMS	ELAPS TIM	
BIT ERR*		
ERR SEC*		
BER*		
OUT SYN SEC*		
SLIPS*		

B. Initiating a Results Print

5.17 A results print can be initiated manually using the PRINT switch, or automatically using the PRINT EVENT switch.

5.18 A results print is also automatically initiated when a result counter overflows. Labeled OVERFLOW PRINT, the printout also describes the reason for the overflow. Each time a result counter overflows, the test result is preceded by a double asterisk (**) on the printout, indicating an "immediate overflow" condition (i.e., the results counter overflowed during the last second). Subsequent

printings of the overflowed result are preceded by a single asterisk (*) to indicate a "previous overflow" condition. All asterisks are cleared at test restart.

```
   RESULTS PRINT
02:56:16       7 OCT
BIT ERR          798
ASYN E SEC         6
BER        3.91 E-06
EFS              127
%EFS           94.78%
SY ERR SEC         4
OUT SY SEC         8
SLIPS              0
SES                8
%SES             5.84%
DEGR MIN           0
%DEGR MIN      00.00%
UNAVL SEC          0
%AVL          100.00%
CSES               1
BPV ERR         2411
BPV ER SEC         7
BPV RATE   1.17 E-05
CRC ERR            8
CRC ER SEC         5
FRA LOS            3
FRA LS SEC         8
CRC SES            8
CRC E RATE    2 E-04
FREQ Hz       1543993
RX LEVEL   +01 dBdsx
RX LEVEL     +17 dBm
SPX CUR UNDER 10 mA
SIG LS SC          5
ALARM SEC        137
TEST LEN    00:15:00
TEST SEC         137
TEST END        ****
ELAPS TIM   00:02:17
RX LVL    6.73 V p-p
   ALARM STATUS
PAT SYNC          ON
T1                ON
FRM SYNC          ON
ALL ONE           ON
ALL ONE HIST      ON
EX ZERO HIST      ON
FRM LOS HIST      ON
PAT LOS HIST      ON
SIG LOS HIST      ON
```

Figure 9—Results Print

C. Controls Print

5.19 The controls print lists the current setting of all front-panel switches and auxiliary functions. A controls print is initiated by pressing the PRINT switch to the CONTROLS position. Figure 10 is an example of a controls printout.

D. Alarm Messages

5.20 Unless the PRINT EVENT switch is set to the OFF position, alarm messages are initiated automatically to inform you of any important developments related to your ongoing test.

```
  CONTROLS PRINT
02:55:37      7 OCT
MODE:           AUX
PATTERN:   ALL ONES
TIMED/CONT:    CONT
DIS HOLD:       OFF
TIMING:         INT
CODE:           AMI
ERR INS BPV:    OFF
ERR INS LOG:    OFF
RCV INPUT:     TERM
TX LBO:          0dB
PRI EVNT:       OFF
CONT/HALT:     HALT
RESPONSE:      AUTO
PARITY:        EVEN
BAUD RATE:     2400
CR/CR-LF:        CR
FORMAT:      NORMAL
```

Figure 10—Controls Print

5.21 The format for an alarm message is:

[alarm message name HH:MM:SS DD:MM]

5.22 Alarm messages are categorized as follows:

(1) ALL ONES, EX ZERO, ONES DENSITY, YELLOW ALM, PULSE SHAPE, AND LOW BATTERY are followed by either ON or OFF to indicate their status. EX ZERO is not applicable with the $2^{20}-1$ or $2^{23}-1$ patterns. The ONES DENSITY alarm message is not applicable when the QRSS, $2^{15}-1$, $2^{20}-1$, $2^{23}-1$, or 3-in-24 data patterns are selected.

(2) PATT LOSS, FRAM LOSS, SIG LOSS are followed by a count of the number of such occurrences during the test.

(3) PATT SYNC ACQUIRED, FRA SYNC ACQUIRED are printed out when synchronization is acquired.

(4) TEST COMPLETE is printed when a timed test is completed (in lieu of printing an entire results print). This alarm message applies only when in TIMED TEST mode and the PRINT EVENT switch is in a position other than TEST END.

(5) TEST RESTART is printed when you press the TEST RESTART switch or any major switch.

NOTE: The term *major switch* applies to the PATTERN, MODE, RESTART, POWER, TIMING, and RECEIVE INPUT switches, and the HLT/CONT and RESPONSE auxiliary functions.

(6) NEW CONFIGURATION indicates a change in status of any major switch.

(7) LOOP DOWN DETECT, LOOP UP DETECT, SIGNAL DETECT, LOOP DOWN LOSS, and LOOP UP LOSS indicate that a specific condition has either been detected or lost.

(8) LOOP DN DURA and LOOP UP DURA indicates the duration time of loop-code transmission. Duration time is the number of seconds from the time loop up (or loop down) starts until it stops.

(9) BUFFER FULL is printed when the print buffer has overflowed. Note that this is the only message that is not date- and time-stamped.

NOTE: Print buffer overflow may result in lost information.

Pulse Shape Printouts

5.23 When using a printer with graphic capability, it is possible to obtain a graphic printout of your current pulse shape. A graphic printout is initiated by selecting the GRAPH auxiliary function, and then pressing the RESULTS I ⇳ switch. Figure 11 shows a sample pulse shape printout.

NOTE: To properly initiate a graphic printout, the T-BERD 209A's RS-232 interface must be set for 8 data bits—set the PARITY auxiliary function to NONE.

Remote Control Operation

5.24 The T-BERD 209A's Remote Control Interface lets you remotely control the T-BERD 209A from a terminal or computer. Under such operation, the instrument's front-panel switches (except for the RESULTS I and RESULTS II CATEGORY and RESULTS switches) are disabled.

5.25 Four primary command types are available with the T-BERD 209A's remote control facility:

(1) Switch commands set the T-BERD 209A's front-panel switches.

(2) Auxiliary commands set the T-BERD 209A's auxiliary functions.

(3) Control commands pertain exclusively to the RS-232 Printer/Remote Control Interface.

(4) BERD-BASIC commands manipulate BERD-BASIC programs.

5.26 These command sets are fully described under Command Formats, respectively.

A. Command Formats

5.27 The general format for any remote control command is:

command_name [parameter]

5.28 The command_name entry specifies the name of the command to be executed. (Remote Control Commands fully describes all remote control commands.) Where possible, commands which represent a front-panel or auxiliary activity are abbreviated to reflect the first three characters of the switch or function. Control commands have no front-panel equivalent, and may either be abbreviated or spelled out.

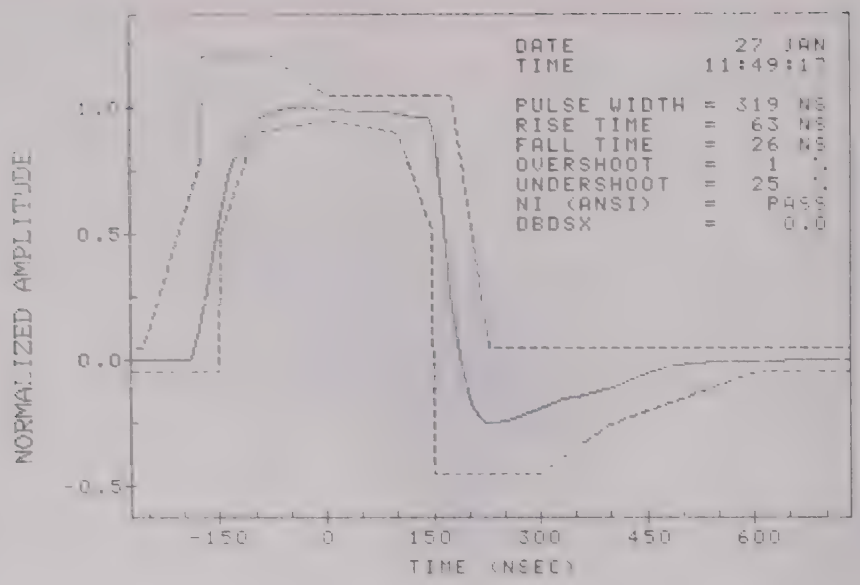

Figure 11—Pulse Shape Printout

5.29 The [parameter] entry specifies any optional parameter(s) associated with the command. If a parameter is entered, it should be separated from the command name by at least one space. The command name [parameter] string should always be followed by a carriage return or carriage return/line feed sequence.

5.30 Most remote control commands can be used to select a new command state or to display the current command state (without changing it). To select a new command state, enter both the command name and the desired parameter on the command line. To display the current state, enter the command name only. Note, however, that some commands (e.g., CLS) are "executable only" and have no current or changeable state.

B. Front-Panel Switch Commands

5.31 Switch commands control the functions normally associated with the T-BERD 209A's front panel. Mnemonics represent the first three characters of the switch name or switch position as it appears on the T-BERD 209A front-panel and in the display. Exponents are lowered to become the last digit of the number (e.g., 10^{-6} becomes 10-6).

5.32 Table 28 lists the switch commands along with their equivalent front-panel switch names. Brackets to the right of the switch name indicate the availability of associated parameters. The parameters associated with each command are fully described in Remote Control Commands.

Table 28—Switch Commands

Front Panel Switches	
Command Name	**Equivalent Front Panel Switch**
CODE [ ]	CODE
CONTROLS	CONTROLS
DIS HOL [ ]	DISPLAY HOLD
ERR INS BPV [ ]	ERROR INSERT BPV
ERR INS FRM [ ]	ERROR INSERT FRAME
ERR INS LOG [ ]	ERROR INSERT LOGIC
HIS RES	HISTORY RESET
LOO DOW [ ]	LOOP DOWN
LOO UP [ ]	LOOP UP
MOD [ ]	MODE
PAT [ ]	PATTERN
PRI [ ]	PRINT
PRI EVE [ ]	PRINT EVENT
REC INP [ ]	RECEIVE INPUT
RES 1 [ ]	RESULTS I
RES 2 [ ]	RESULTS II
RESTART	RESTART
RESULTS	RESULTS
TEST [ ]	TEST
TIM [ ]	TIMING
TRA OUT [ ]	TRANSMIT OUTPUT

C. Auxiliary Function Commands

5.33 Auxiliary commands control the functions normally associated with the T-BERD 209A's AUX mode.

5.34 Table 29 lists the auxiliary function commands along with their equivalent AUX mode names. Brackets following the command name indicate the command has associated parameters. The parameters associated with each command are fully described in Remote Control Commands.

Table 29—Auxiliary Function Commands

Command Name	Equivalent Auxiliary Function
BAUD	BAUD
BURST LEN [ ]	ERR SEL
CLOCK [ ]	CLOCK
DATA BITS	PARITY
DATE [ ]	DATE
ERROR RATE [ ]	ER RATE
FRM ERR LEN [ ]	FRM ERR
GRAPH PULSE	GRAPH
LOOP CODE [ ]	LP CODE
PARITY	PARITY
PGM LPDN [ ]	PGM LPDN
PGM LPUP [ ]	PGM LPUP
PGMPAT 1 [ ]	USER1
PGMPAT 2 [ ]	USER2
PRI FMT [ ]	PRNT FMT
PULSE MASK [ ]	PLS MASK
PWR SAVE [ ]	PWR SAVE
RESPONSE [ ]	RESPONSE
SYN LOS ACT [ ]	HALT/CONT
TERM 232 [ ]	TERM
TIM SET [ ]	TEST LEN

NOTE: BAUD, DATA BITS, and PARITY are read-only commands; they can display (but cannot change) the current setting.

D. Control (Non-Switch) Commands

5.35 Control commands have no front panel or AUX equivalent. These commands are used to obtain information from the T-BERD 209A or to modify the remote control/printer protocol.

5.36 Table 30 lists the control commands. Brackets following the command name indicate that the command has associated parameters. The parameters associated with each command are fully described in Remote Control Commands.

NOTE: With the exception of the HELLO and LEDS commands, all commands without brackets are "executable only" and have no status to return.

Table 30—Control Commands

ALARM [ ]	HOLD
BEEP	LEDS
CLEAR FIFO	LOCAL (/)
CLS	MESSAGES [ ]
DEVICE CLEAR	PRINT [ ]
DISPLAY [ ]	PROMPT [ ]
ECHO [ ]	REL
FIRST P.U.	REMOTE
FORMAT	TERMINAL (.)
HELLO	UNFORMAT
HELP [ ]	

E. BERD-BASIC Commands

5.37 The T-BERD 209A Remote Control Interface offers you the ability to create a BERD-BASIC program. A BERD-BASIC program is simply a sequence of commands that instruct the T-BERD 209A to perform desired functions. By "taking control" of the T-BERD 209A, a BERD-BASIC program can be executed (possibly many times) without the presence of a remote user.

5.38 A BERD-BASIC program line is composed of a remote control command and a line number. The command tells the T-BERD 209A what to do; the line number (any value between 0 and 29779) determines the order in which the commands are executed. Program lines may be entered in any sequence; the T-BERD 209A automatically sorts them in ascending order. A program is executed starting with the lowest numbered line and proceeding, in sequence, to the highest numbered line. Any line number that is not followed by a command is deleted.

5.39 Table 31 lists the BERD-BASIC commands. Each BERD-BASIC command is fully described in Remote Control Commands.

Table 31—BERD-BASIC Commands

CONT	MACRO
END	NEW
GOTO	REM
INPUT	RUN
LIST	STOP
LPRINT	

F. Configuring the T-BERD 209A for Remote Control

5.40 Prior to entering Remote Control mode, you must first set baud and parity so that the T-BERD 209A is configured to communicate with the remote controller. Baud and parity can be configured as follows:

(1) Manually using the BAUD and PARITY auxiliary functions.

(2) Automatically using the Auto Baud function.

5.41 The T-BERD 209A is manually configured by setting the BAUD and PARITY auxiliary functions to values identical to those set for your remote control device. BAUD can be set to 300, 1200, 2400, or 4800. PARITY can be set to ODD, EVEN, or NONE.

NOTE: When PARITY is set to ODD or EVEN, the number of data bits equal 7; when PARITY is set to NONE, the number of data bits equal 8.

5.42 The Auto Baud function allows baud, data bits, and parity values to be automatically configured. The Auto Baud function offers possible baud rate settings of 110, 300, 600, 1200, 2400, 4800, 9600, and 19200. Possible parity settings are even, odd, or none.

NOTE: Baud, parity, and data bit settings return to their original values when control of the T-BERD 209A is returned to the front-panel.

5.43 To establish communication with the remote control unit through the Auto Baud function, perform these steps at the remote control unit.

(1) Press the BREAK key three times slowly (once per second). (On some terminals, the CTL key and the BREAK key must be pressed simultaneously.)

(2) Press and hold the space bar until the message "Auto-baud achieved. Press ESCAPE to continue" appears. (If the space bar does not have an auto-repeat function, press the space bar repeatedly until the message appears.)

(3) Press the ESCAPE key — the message "Character format determined" is displayed.

NOTE: Between each of the above steps, the T-BERD 209A waits for 30 seconds. If no key is pressed within the 30-second period, the Auto Baud function is aborted.

5.44 Once the T-BERD 209A is configured to communicate with the controller, Remote Control mode may be entered by typing a valid remote control command or a period (.). The period sets the T-BERD 209A for terminal (CRT) control.

G. Input Sequence

5.45 A remote control command consists of an ASCII character string followed by either a carriage return (CR) or a carriage return/line feed (LF) sequence. When specifying a remote control command, the following rules apply:

(1) Commands may be entered in lower or upper case.

(2) Spaces may be inserted before (or after) the command name. Spaces **must** be inserted between the command name and a parameter.

(3) Entering a CTL C (Control C) or a CTL X (Control X) prior to issuing a CR or LF cancels the input line.

(4) Entering a CTL H (Control H) or BACK SPACE erases the last character entered.

(5) Up to 20 previously entered commands can be recalled using the ESC key. When the number of previously entered commands exceeds 20, the earliest command entries are overwritten.

5.46 After receiving a carriage return or a carriage return/line feed sequence, the T-BERD 209A analyzes the data in its input buffer. If a parity error, overrun error, framing error, input buffer overflow, program memory overflow, or any syntax error is detected, the appropriate error message is returned to the controller. If no errors are detected, the command is decoded and the appropriate response is generated.

5.47 If the ECHO feature is enabled, the entered characters are echoed back to the controller. If the PROMPT command is enabled, the default prompt (">") or a user-defined prompt (a single character or a string) indicates that previous commands have been processed and that the T-BERD 209A is ready to receive additional commands. Note that the TERMINAL command automatically enables ECHO and PROMPT when entering remote control mode.

5.48 When either the PROMPT or ECHO feature are enabled, any characters used to cancel a line (e.g., CTL C) are echoed to the remote control unit.

H. Output Sequence

5.49 The following rules apply for output sequence:

(1) If the ECHO feature is enabled, echoed outputs have higher priority than the printer outputs. This means that printer output is suspended if there are any echoed outputs available (include user inputs or error messages) at the end of each line of printer output. Printer output resumes when the echo FIFO is empty.

(2) The HOLD command suspends printer output until the REL command is specified. When the HOLD command is specified, the prompt character automatically changes to a "+" to remind you that data is waiting to be printed. After the REL command is entered, the default prompt (">") or the user-defined prompt is returned.

(3) CNTL S suspends printer output without changing the prompt character. Entering CTL Q (Control Q), a carriage return, or CTL S a second time releases printer output suspended by CTL S.

(4) Entering CTL C (Control C) clears the entire printer FIFO.

I. Error Messages

5.50 Most error messages contain the prefix ERROR and are terminated by a CR or CRLF sequence, as selected. The following is a list of the possible error messages.

ERROR: *BAUD is not an executable command.*
You attempted to change the baud rate in remote control mode.

ERROR: *Burst length set to single.*
You attempted to insert a burst of logic or BPV errors with the ERR SEL auxiliary function set to SINGLE.

ERROR: *Can't continue.*
You attempted to continue a BERD-BASIC program that has been altered (i.e., lines have been changed) since the last STOP command.

ERROR: *Characters after statement end.*
The T-BERD 209A found additional characters at the end of a valid command.

ERROR: *Command not allowed in program.*
Your BERD-BASIC program contains a command which is only executable as a direct command from the remote controller.

ERROR: *Command only allowed in program.*
You attempted to execute a command from the remote control which is only executable in a BERD-BASIC program.

ERROR: *DATA BITS is not an executable command.*
You attempted to change the data bit setting in remote control mode.

ERROR: *Illegal delimiter.*
A delimiter (":", ",", etc.) which is required in command syntax is not found.

ERROR: *Illegal line number.*
A non-existent BERD-BASIC program line is referenced (e.g., by a GOTO command) or you entered a program line with a value greater than 29779.

ERROR: Illegal value.
The value supplied with the command is outside the valid range for the function requested.

ERROR: *Macros nested more than 5 deep.*
A macro is attempting to recall itself or another macro more than five times.

ERROR: *Must be specified by a parameter.*
You did not specify a parameter that is required for command execution.

ERROR: *Parameter is out of range.*
You specified a parameter value that is outside the valid range (e.g., supplying the value 32 for the day of the month).

ERROR: *PARITY is not an executable command.*
You attempted to change parity value in remote control mode.

ERROR: *Program memory overflow.*
You entered a BERD-BASIC program that is too long to fit into memory.

ERROR: *Result is not applicable to mode.*
The T-BERD 209A is in a mode in which the requested result is not applicable.

ERROR: *Result is not available.*
You requested a result whose value cannot be computed. This condition can occur when the T-BERD 209A is out of frame or pattern synchronization and a result is specified that is only available when the T-BERD is in frame or pattern synchronization.

ERROR: *RS-232 Receiver buffer overflow.*
A command is greater than 512 characters in length or commands were entered too quickly.

ERROR: *RS-232 Receiver framing error.*
The T-BERD 209A detects one or more asynchronous framing errors in the input command. This may occur if the controller's data format is different from that of the T-BERD.

ERROR: *RS-232 Receiver overrun error.*
The remote control device is sending characters to the T-BERD 209A while the Clear To Send (CTS) control signal is OFF (false), indicating that the T-BERD is not ready for more data. Solution: respond to signaling.

ERROR: *RS-232 Receiver parity error.*
The T-BERD 209A received one or more characters with a parity error.

ERROR: *There is no such page for help information.*
You requested information beyond the number of pages available for a HELP activity. Suggestion: issue the HELP 1 command to learn how many pages of HELP information are currently available.

ERROR: *Timing must be INT when in SELF TEST mode.*
You attempted to change the timing source to a selection other than internal (INT) while in SELF TEST mode.

ERROR: *Unrecognized command.*
The T-BERD does not recognize the command name entered in the command line.

ERROR: *Unrecognized parameter.*
The T-BERD 209A recognizes the requested command, but cannot interpret the specified command parameter.

A **WARNING** message tells you that the T-BERD 209A did something out of the ordinary to process a command.

WARNING: *External clock is not present.*
Though specified in the TIM command, an external clock source is not present. In such instances, timing is taken from the T-BERD 209A's internal clock source.

WARNING: *Value has been rounded down.*
To be processed, the command value that you entered has been rounded to the nearest allowable lesser value (see the BURST LEN command).

Remote Control Commands

5.51 This section presents all of the remote control commands in alphabetical order. For each command there is an explanation of the command, references to associated commands, and a brief example of command usage.

ALARM

Alarm Message Prints

ALARM :Print the alarm message print status
ALARM [ON / OFF] :Enable or disable alarm message prints

ALARM sets or returns alarm message print status, and enables or disables the printing of alarm messages (see Alarm Messages). When the **ON** selection is chosen, alarm messages are printed. When the **OFF** selection is chosen, alarm messages are not printed. When the **PRI EVE** command is **OFF,** the **ALARM ON** command has no effect because no printouts are enabled.

EXAMPLE:

```
>ALARM OFF          :disable alarm message prints
>ALARM              :print the current alarm status
  OFF
>
```

BAUD

Display the Current Baud Rate Setting

BAUD

BAUD is used to obtain the T-BERD 209A's current baud rate setting. Note that BAUD is an "inquire only" command: you cannot change the baud rate via remote control. The baud rate can be set manually using the BAUD auxiliary function, or can be set automatically using the auto-baud capability.

The BAUD auxiliary function provides baud rate settings of 300, 1200, 2400, and 4800. The auto-baud capability can be used to obtain baud rate settings of 110, 300, 600, 1200, 2400, 4800, 9600, and 19200.

EXAMPLE:

```
>BAUD                          :display the current baud rate setting
  1200
>BAUD 2400                     :try to set a new baud rate
  ERROR: BAUD IS NOT AN EXECUTABLE COMMAND
>
```

BEEP

Sound the Remote Control Unit's Beeper

BEEP

BEEP causes the remote control unit to sound a single short beep.

EXAMPLE:

```
>BEEP                          :sound the terminal beeper once
>BEEP                          :and again
>
```

BURST LEN

Burst Duration For BPV and Logic Errors

BURST LEN :Display the current burst duration time
BURST LEN value :Set the burst duration time

The **BURST LEN** command controls the burst duration time interval. The valid range of burst duration times is 0.025–5.0 seconds. Any burst duration time without a decimal point is a value expressed in milliseconds, and must be within the range of 25–5000. Any burst duration time with a decimal point is a value expressed in seconds, and must be within the range 0.025–5.0.

This command allows you to select these burst length values:
- 25 ms. to 200 ms. in increments of 25 ms.
- 250 ms. to 500 ms. in increments of 50 ms.
- 600 ms. to 1.5 seconds in increments of 100 ms.
- 2.0 seconds to 5.0 seconds in increments of 500 ms.

A value that is not one of the incremental values is always rounded to the nearest allowable lesser value. If a value has a decimal point, the digits after the third fractional position are ignored.

This command is identical in function to setting burst duration using the ERR SEL auxiliary function (see Switches).

EXAMPLE:

```
>BURST LEN 24                  :the smallest allowed value is 25 ms.
  ERROR: PARAMETER IS OUT OF RANGE
>BURST LEN 5001                :the largest allowed value is 5000 ms.
  ERROR: PARAMETER IS OUT OF RANGE
>BURST LEN 0.024               :the smallest allowed decimal value is 0.025
  ERROR: PARAMETER IS OUT OF RANGE
>BURST LEN 5.001               :the largest allowed decimal value is 5.000
  ERROR: PARAMETER IS OUT OF RANGE
>BURST LEN 3.0                 :a 3-second burst duration is specified
>
```

CLEAR FIFO

Clear the Print FIFO

CLEAR FIFO

CLEAR FIFO command clears the print FIFO of all printouts that are awaiting printing.

EXAMPLE:

```
>CLEAR FIFO                    :clear the print FIFO
>
```

CLOCK

Clock Time

CLOCK :Print the clock time (time of day)
CLOCK hh:mm :Set the clock time

CLOCK sets or returns the clock time. The time is entered in 24-hour format; seconds are always set to zero when a new time is entered. This command is equivalent to the CLOCK auxiliary function.

EXAMPLE:

```
>CLOCK                  :print the clock time
  15:30:24              :time is displayed in hours, minutes, and seconds
>CLOCK 6:28             :set clock time to 6:28 a.m.
>
```

CLS

Clear the Terminal Screen

CLS

CLS enables you to output 30 of the selected line terminator sequences (usually CRLF for terminals) to your terminal. This has the effect of clearing the terminal screen of all previous outputs.

EXAMPLE:

```
>CLS                    :clear the terminal screen
  .                     :30 line terminators transmitted
  .
  .
>
```

COD

Select Code Type

COD :Display the current code status
COD [AMI / B8Z] :Set the code type

COD selects or returns the current code type used by the T-BERD 209A transmitter. When you select **AMI**, AMI coding is enabled; when you select **B8Z**, B8ZS coding is enabled. Note that B8ZS decoding is always available on the receive side.

This command is equivalent to the CODE switch on the T-BERD 209A's front panel.

EXAMPLE:

```
>COD                    :display the current COD status
  AMI
>COD B8Z                :enable B8ZS coding
>
```

CONT

Resume BERD-BASIC Program Execution

CONT

CONT resumes the running of any BERD-BASIC program which has been suspended due to execution of a **STOP** command. Using the **STOP** and **CONT** commands, you can temporarily suspend program execution and resume it at a later time.

Program execution cannot be **CONT**INUED if any existing line in a program has been changed, or if a program has reached its conclusion.

See also: **STOP**.

EXAMPLE:

```
>10 LPRINT "FIRST HALF"     :this program runs in two halves . . .
>20 STOP                    : . . . with a STOP in the middle
>30 LPRINT "SECOND HALF"
>40 END
>RUN                        :run the program
  FIRST HALF                :the program stops running . . .
  BREAK IN LINE 20          : . . . due to the STOP command in line 20
>CONT                       :continue running the program
  SECOND HALF
  *DONE*                    :the program is finished
>
```

CONTROLS

Generate a Controls Printout

CONTROLS

CONTROLS allows you to initiate a printout of all current T-BERD 209A switch settings. This command is functionally identical to pressing the CONTROLS position of the PRINT switch on the T-BERD 209A's front-panel.

The effect of this command is identical to issuing the PRI CON remote control command.

EXAMPLE:

```
>CONTROLS                    :generate a controls print
  .                          :controls print follows
  .
  .
>                            :controls print ends
```

DATA BITS

Display the Current RS-232 Data Bit Setting

DATA BITS

DATA BITS displays the current data bit setting for the remote RS-232 port on the T-BERD 209A. Note that this is an "inquire-only" command; you cannot change the setting via remote control. The data bit setting is based on the current setting of the PARITY auxiliary function; data bits can also be automatically set using the auto-baud capability.

EXAMPLE:

```
>DATA BITS                   :display current data bits
  7
  .
```

DATE

Calendar Date

DATE :Display the date
DATE dd/mm :Set the date

DATE sets or returns the calendar day and month.

EXAMPLE:

>**DATE** :display the date
4 SEP
>**DATE 18/5** :set date to May 18

DEVICE CLEAR

Clear Device

DEVICE CLEAR

DEVICE CLEAR clears the T-BERD 209A by executing the power-up procedure. The entire instrument is reinitialized - hardware and RAM.

NOTE: When specified, this command returns control of the T-BERD 209A to the front panel of the instrument. Remote control mode must be reestablished.

EXAMPLE:

>**DEVICE CLEAR** :execute instrument power-up
:exit remote control mode

DIS HOL

Freeze the Results Displays

DIS HOL :Display the current status of DISPLAY HOLD
DIS HOL [ON / OFF] :Set DISPLAY HOLD

DIS HOL controls the front panel results displays. **DIS HOL ON** freezes the results displays. Note that when **DIS HOL ON** is enabled during a test, the T-BERD 209A continues to accumulate test results. **DIS HOL OFF** disables the DISPLAY HOLD function.

This command is identical in function to the DISPLAY HOLD switch on the front panel of the T-BERD 209A (see Switches).

EXAMPLE:

```
>DIS HOL                    :view current status of DISPLAY HOLD
  OFF
>DIS HOL ON                 :the results display is frozen
>
```

DISPLAY

Front-Panel Display Mode

DISPLAY :View current mode of display control
DISPLAY [LOCAL / REMOTE] :Set display control

DISPLAY determines whether the RESULTS I and RESULTS II switches are active when the T-BERD 209A is under remote control. Note that these are the only switches that can be optionally active on the T-BERD 209A.

DISPLAY LOCAL activates the CATEGORY and RESULT switches. (**DISPLAY LOCAL** is the default for Remote Control mode.) **DISPLAY REMOTE** disables the CATEGORY and RESULT switches.

EXAMPLE:

```
>DISPLAY                    :view current mode of display control
LOCAL
>DISPLAY REMOTE             :set display control to remote
>
```

ECHO

Echo Mode

ECHO :Display echo status
ECHO [ON / OFF] :Set echo mode

ECHO determines whether characters entered from the remote control unit are displayed. **ECHO ON** enables all characters entered from the remote control unit to be displayed. **ECHO OFF** disables echo, and inhibits the printing of characters entered from the remote control unit.

EXAMPLE:

```
>ECHO                    :view echo status
  ON
>ECHO OFF                :turns echo off
>(CLOCK)                 :CLOCK is specified—but not echoed
  12:03:32               :the time is displayed
>
```

END

End a BERD-BASIC Program

END

END marks the final statement of any BERD-BASIC program, terminating execution and causing the message *DONE* to be sent to the remote control unit. Note that the *DONE* message is sent whenever the end of a program is reached successfully (even if the **END** command is not specified).

EXAMPLE 1:

```
>10 LPRINT "HI"
>RUN
  HI
  *DONE*
```

EXAMPLE 2:

```
>10 LPRINT "HELLO"
>20 LPRINT "HOW ARE YOU"
>30 END
>RUN
  HELLO
  HOW ARE YOU
  *DONE*
>
```

ERR INS BPV

BPV Error Insertion

ERR INS BPV	:Display current BPV error insertion rate status
ERR INS BPV RATE	:Continuously insert BPVs into the data stream
ERR INS BPV BURST	:Insert a single burst of BPVs
ERR INS BPV SIN	:Insert a single BPV
ERR INS BPV OFF	:Stop the insertion of BPVs

ERR INS BPV controls the insertion of BPVs into the data stream.

ERR INS BPV RATE inserts BPVs into the data stream at the rate specified in the ER RATE auxiliary function or the ERROR RATE remote control command. **ERR INS BPV OFF** stops the insertion of BPVs.

ERR INS BPV BURST inserts a single burst of BPVs into the data stream at the rate specified in the ER RATE auxiliary function or the ERROR RATE remote control command. The burst length is based on the length of time specified in the ERR SEL auxiliary function or the BURST LEN remote control command. Note that an error message is printed when the burst length is SINGLE or set to 0 ms.

ERR INS BPV SIN lets you insert a single BPV into the data stream. When specified, ERR SEL and BURST LEN are automatically set to SINGLE and 0, respectively.

See also: **ERROR RATE**

EXAMPLE:

```
>ERR INS BPV                :display BPV insertion rate status
  OFF                       :BPV insertion rate is off
>ERR INS BPV RAT            :"turn on" BPV insertion rate
>ERR INS BPV SIN            :insert a single BPV and end rate insertion
>ERR INS BPV                :view current BPV insertion rate status
  OFF
>
```

ERR INS FRM

Frame Error Insertion

ERR INS FRM :Display the current frame error insertion rate status
ERR INS FRM CONT :Continuously insert single or multiple consecutive frame errors into the data stream
ERR INS FRM MULTI :Insert one round of single or multiple consecutive frame errors
ERR INS FRM SIN :Insert a single frame error
ERR INS FRM OFF :Stop the insertion of frame errors

ERR INS FRM controls the insertion of frame errors into the data stream.

ERR INS FRM CONT continuously inserts single or multiple consecutive frame errors into the data stream. Frame errors are inserted at the rate specified in the FRM ERR auxiliary function (see Auxiliary Functions) or the FRM ERR LEN remote control command (valid range: 1-6). **ERR INS FRM OFF** stops the insertion of frame errors.

ERR INS FRM MULTI inserts a single round of frame errors into the data stream at the rate specified in the FRM ERR auxiliary function (see Auxiliary Functions) or the FRM ERR LEN remote control command. **ERR INS FRM SIN** lets you insert a single frame error into the data stream.

See also: **FRM ERR LEN**

EXAMPLE:

```
>ERR INS FRM                :display frame error insertion rate status
 OFF                        :frame error insertion rate is off
>ERR INS FRM CONT           :''turn on'' frame error insertion rate
>ERR INS FRM SIN            :insert a single frame error and end rate insertion
 OFF
>
```

ERR INS LOG

Logic Error Insertion

ERR INS LOG	:Display current logic error insertion rate status
ERR INS LOG RATE	:Continuously insert logic errors into the data stream
ERR INS LOG BURST	:Insert a single burst of logic errors
ERR INS LOG SIN	:Insert a single logic error
ERR INS LOG OFF	:Stop the insertion of logic errors

ERR INS LOG controls the way logic errors are inserted into the data stream.

ERR INS LOG RATE inserts logic errors into the data stream at the rate specified in the ER RATE auxiliary function (see Auxiliary Functions) or the ERROR RATE remote control command. **ERR INS LOG OFF** stops the insertion of logic errors.

ERR INS LOG BURST inserts a single burst of logic errors into the data stream at the rate specified in the ER RATE auxiliary function or the ERROR RATE remote control command. The burst length is based on the length of time specified in the ERR SEL auxiliary function or the BURST LEN remote control command. Note that an error message is printed when the burst length is SINGLE or set to 0 ms.

ERR INS LOG SIN lets you insert a single logic error into the data stream. When specified, ERR SEL and BURST LEN are automatically set to SINGLE and 0, respectively.

See also: **ERROR RATE**

EXAMPLE:

>**ERR INS LOG**	:display logic error insertion rate status
OFF	:logic error insertion rate is off
>**ERR INS LOG RATE**	:''turn on'' logic error insertion rate
>**ERR INS LOG SIN**	:insert a single logic error and end rate insertion
>**ERR INS LOG**	:view current logic error insertion rate status
OFF	
>	

ERROR RATE

BPV and Logic Error Insertion Rate

ERROR RATE :Display the current error insertion rate
ERROR RATE rate-value :Set a new error insertion rate

ERROR RATE controls the rate at which BPV and logic errors are inserted into the data stream. The range of valid error insertion rate values is 1.0 E-2 through 1.0 E-9.

The **rate-value** of the **ERROR RATE** command is entered in an XX,y format, and is interpreted as X.X E-y.

See also: **ERR INS BPV ERR INS LOG**

EXAMPLE:

```
>ERROR RATE                :display the current error insertion rate
  1.0 E-7                  :the current error insertion rate is 1.0 E-7
>ERROR RATE 10,5           :change the error insertion rate to 1.0 E-5
>
```

FIRST P.U.

First Power-Up

FIRST P.U. :Resets NOVRAM to factory settings

FIRST P.U. both reloads factory settings into non-volatile memory (NOVRAM) locations and initiates an auto-calibration on the T-BERD 209A. Note that you will no longer be in remote control mode after executing this command.

IMPORTANT: To continue beyond the reloading of NOVRAM, you must press the RESTART button on the T-BERD 209A's front-panel.

EXAMPLE:

```
>FIRST P.U.                :reload NOVRAM with factory settings
                           :exit remote control mode
```

FORMAT

Formatted Printouts

FORMAT

FORMAT inserts blanks between words so that output from the T-BERD 209A is easy to read. The **FORMAT** command (as opposed to the **UNFORMAT** command) is the default for Remote Control mode; when the T-BERD 209A changes control mode (from local to remote or vice versa), the current setting remains unchanged.

See also: **UNFORMAT**

EXAMPLE:

```
>10 FORMAT                          :set formatted print
>20 LPRINT THERE ARE BLANKS
>RUN
 THERE ARE BLANKS                   :formatted print from line 20
>
```

EXAMPLE 2:

```
>10 UNFORMAT                        :set unformatted print
>20 LPRINT THERE ARE NO BLANKS
>RUN
 THEREARENOBLANKS                   :unformatted print from line 20
>
```

FRM ERR LEN

Frame Error Insertion Rate

FRM ERR LEN :Display the current frame error insertion rate
FRM ERR LEN [1,2,3,4,5,6] :Set a new frame error insertion rate

FRM ERR LEN controls the rate at which frame errors are consecutively inserted into the data stream.

See also: **ERR INS FRM**

EXAMPLE:

```
>FRM ERR LEN                        :display the current frame error insertion rate
 4                                  :the current frame error insertion rate is 4
>FRM ERR LEN 5                      :change the frame error insertion rate to 5
>
```

GOTO

Transfer Program Execution to a Specified Line

GOTO linenumber

The **GOTO** command alters the sequence in which the T-BERD 209A executes commands in a BERD-BASIC program. When encountered in a running program, the **GOTO** command transfers execution to the command associated with the specified line number (as opposed to the next line in sequence).

This command is used in a BERD-BASIC program only.

EXAMPLE:

```
>10 LPRINT START HERE
>20 GOTO 40
>30 LPRINT THIS LINE IS NEVER PRINTED
>40 LPRINT JUMP TO HERE
>RUN
 START HERE
 JUMP TO HERE                    :line 30 is skipped
 *DONE*
>
```

GRAPH PULSE

Initiate a Pulse Shape Printout

GRAPH PULSE

GRAPH PULSE allows you to initiate a graphic printout of a pulse shape. This command is identical to the GRAPH auxiliary function.

NOTE: The **GRAPH PULSE** command should only be used if your remote controller has graphic capability.

EXAMPLE:

```
>GRAPH PULSE                     :initiate a pulse shape printout
>.                               :pulse shape printout starts
>.
>.
>                                :pulse shape printout is completed
```

HELLO

Display T-BERD 209A Hardware and Software Revision Level

HELLO

HELLO displays the T-BERD 209A's hardware and software revision levels, as well as any options that are included in the instrument.

EXAMPLE:

```
>HELLO                          :display the hardware and software revision level
  T-BERD 209A
  SW Rev. A
  HW Rev. 010..
  Battery Option Included
>
```

HELP

On-Line Help Function

HELP	:Display introductory help information
HELP HELP	:List an index to all help information
HELP !	:List all valid remote control commands
HELP command-name	:Display command-name syntax
HELP number	:Print a page of help information number: 1 to 8
HELP 1	:Equivalent of **HELP**

HELP provides access to the T-BERD 209A's on-line help facility. **HELP** offers summary on-line help information. **HELP HELP** provides an index to the various types of help information. **HELP!** lists all valid T-BERD 209A remote control commands.

HELP number displays a specific page of help information related to the following:

• **HELP 1**	Introductory help information
• **HELP 2**	Special characters
• **HELP 3**	Front panel switch commands
• **HELP 4/5**	Auxiliary function commands
• **HELP 6/7**	Special commands
• **HELP 8**	BERD-BASIC commands

HELP command-name defines and displays the command syntax for any specified remote control command. The following conventions apply:

1. Command parameters are presented as upper case character strings (see Example 1).
2. Command and parameter summaries are preceded by three dashes (---) (see Examples 2 and 3).

EXAMPLE 1:

```
>HELP ERR INS BPV
  OFF                    :these are command parameters
  RATE                   :valid commands are ERR INS BPV OFF,
  BURST                  :ERR INS BPV RATE, etc.
  SIN
```

EXAMPLE 2:

```
>HELP CLOCK
HH,MM                    :these are the valid formats for the CLOCK command
HH.MM
HH/MM
HH;MM
HH:MM
HH-MM
---HH 0 TO 23 HOURS      :these are the valid ranges
---MM 0 TO 59 MINUTES
```

EXAMPLE 3:

```
>HELP NEW                :summarize the NEW command
---ERASE THE EXISTING BASIC PROGRAM.
```

HIS RES

Reset Alarm History LED Indicators

HIS RES

HIS RES resets all alarm history LED indicators. This command is identical in function to the HISTORY RESET switch on the T-BERD 209A's front panel.

EXAMPLE:

```
>HIS RES                    :clear history LED indicators
```

HOLD

Hold All Printer Outputs

HOLD

HOLD temporarily holds all printer output (in the print buffer) until a **REL** command is specified. Note that while the **HOLD** command is enabled, the prompt character changes from the standard ">" (or user-specified prompt) to a "+" to indicate that printer output is being held.

See also: **REL**

EXAMPLE:

```
>HOLD                       :hold all printouts for now . . .
+CLOCK                      : . . . then print the time and date
+DATE                       :(note that nothing is printed)
+REL                        :start printing . . .
>                           : . . . and the prompt is changed back to ">"
  12:34:56                  :The T-BERD 209A prints the time . . .
  14 APR                    : . . . and date
>
```

INPUT

Enter User Input Into a Macro

INPUT m :Prompt user with a question mark
INPUT m/prompt-string :Prompt user with string

INPUT is used to enter user input into a macro. A macro is a string of characters that are defined once and recalled using one or two key strokes. Note that the **INPUT** command is a BERD-BASIC command only.

When running a BERD-BASIC program with INPUT commands, the T-BERD 209A prompts you with a string (**INPUT m/prompt-string**) or a question mark (**INPUT m**). (The parameter **m** is a number from 0 to 9.) You can specify a response (to a maximum of 31 characters) which is stored as a macro.

See also: **MACRO**

EXAMPLE:

```
>10 INPUT 2
>20 INPUT 3/TIME                :TIME is a prompt string for MACRO 3
>RUN
?PRINT BIT ERRORS               :respond to "?" with PRINT BIT ERRORS
  TIME?PRINT CLOCK TIME         :respond to prompt with PRINT CLOCK TIME
  *DONE*
>&2                             :call MACRO 2 (PRINT BIT ERRORS)
  1211                          :bit error results are displayed
>&3                             :call MACRO 3 (PRINT CLOCK)
  11:22:33                      :the clock time is displayed
>MACRO 2                        :display the contents of MACRO 2
  PRINT BIT ERRORS
>MACRO 3                        :display the contents of MACRO 3
  PRINT CLOCK TIME
>
```

LEDS

Display the State of Front Panel LEDS

LEDS

LEDS displays the state of the T-BERD 209A's alarm and status LED indicators. When specified, this command displays the LED indicators as they appear on the front panel.

EXAMPLE:

>LEDS

```
          —ALARMS—                —STATUS—
ON   OFF  SIGNAL LOSS       OFF  T1 PULSES
ON   OFF  PATTERN LOSS      ON   T1C PULSES
OFF  OFF  FRAME LOSS        ON   PATTERN SYNC
OFF  OFF  ONES DENSITY      OFF  FRAME SYNC
ON   OFF  EXCESS ZEROS      OFF  B8ZS
OFF  OFF  YELLOW ALARM
OFF  OFF  ALL ONES
OFF  OFF  PULSE SHAPE
OFF  OFF  LOW BATTERY
OFF  OFF  POWER LOSS

—RECEIVE LOOP CODES—
OFF  PRE-EXIST LOOP
OFF  LOOP UP
OFF  LOOP DOWN

>
```

LIST

List the Working BERD-BASIC Program

LIST :List the entire program
LIST linenumber :List starting with specified line number

LIST displays the contents of the currently active BERD-BASIC program in ascending numerical order, and displays the number of unused bytes in program memory. If a line number is not specified, the listing starts with the first line of the program; otherwise, the listing starts with the specified line number.

EXAMPLE:

```
>10 CLOCK                :enter CLOCK as line 10
>30 DATE                 :enter DATE as line 30
>20 CLS                  :enter CLS as line 20
>LIST
 10 CLOCK
 20 CLS
 30 DATE
 [489 BYTES FREE]
>
```

LOCAL

Return the T-BERD 209A to Local Mode

LOCAL :Enter Local mode
/ :Alternate form of the **LOCAL** command

LOCAL returns the T-BERD 209A to Local mode from Remote Control or Terminal mode. In Local mode, all of the T-BERD 209A's front-panel switches are active regardless of the display mode.

The T-BERD 209A remains in Local mode until you specify a REMOTE, TERMINAL, period (.), or other valid remote control command from the remote control unit.

When Local mode is specified, note that the remote control unit is disabled if the baud rate settings of the remote control unit and the T-BERD 209A do not match.

See also: **DISPLAY, REMOTE, TERMINAL**

EXAMPLE:

```
>LOCAL                  :enter Local (front panel) mode . . .
  REMOTE                : . . . then return to remote control mode
/                       :quickly return to Local mode (prompt and echo are not enabled)
```

LOO DOW

Generate Loop-Down Code

LOO DOW :Display current status of loop-down code
LOO DOW [ON/OFF] :Enable or disable loop-down code transmission

LOO DOW returns loop-code transmission status. **LOO DOW ON** enables the transmission of loop-down code. The transmission of the loop-down code continues until it is no longer detected at the T-BERD 209A's receiver or until you issue the **LOO DOW OFF** command.

See also: **LOOP CODE** and **PGM LPDN**

EXAMPLE:

```
>LOO DOW                :display status of loop-down code
  OFF
>LOO DOW ON             :activate loop-down code transmission
>
```

LOOP CODE

Select Loop Code Pattern

LOOP CODE	:Display current loop code pattern selection
LOOP CODE CSU	:Select CSU loop code pattern
LOOP CODE FAC1	:Select facility loop code pattern 1
LOOP CODE FAC2	:Select facility loop code pattern 2
LOOP CODE PGM	:Select user-programmed loop code pattern

LOOP CODE sets or returns the current loop code pattern selection. **LOOP CODE** displays current loop code pattern selection. **LOOP CODE CSU** selects CSU loop code (loop-up code: 10000; loop-down code: 100); **LOOP CODE FAC1** selects facility loop-code (loop-up code: 1100; loop-down code: 1110); **LOOP CODE FAC2** offers a second facility loop code selection (loop-up code: 11000; loop-down code: 11100); **LOOP CODE PGM** selects the user-programmed loop codes defined by the PGM LPUP and PGM LPDN auxiliary functions.

See also: **LOO DOW, LOO UP, PGM LPDN, PGM LPUP**

EXAMPLE:

```
>LOOP CODE                    :display current loop code pattern selection
 CSU
>LOOP CODE PGM                :select user-programmable loop code
>
```

LOO UP

Generate Loop-Up Code

LOO UP	:Display current status of loop-up code
LOO UP [ON/OFF]	:Enable or disable loop-up code transmission

LOO UP returns loop-up transmission status. **LOO UP ON** enables the transmission of loop-up code. The transmission of the loop-up code continues until it is detected for 250 ms at the T-BERD 209A's receiver, or until you issue the **LOO UP OFF** command.

See also: **LOOP CODE** and **PGM LPUP**

EXAMPLE:

```
>LOO UP                       :display current status of loop-down code
 OFF
>LOO DOW ON                   :activate loop-up code transmission
>
```

LPRINT

Print a Literal Text String

LPRINT string

LPRINT sends a text string during the execution of a BERD-BASIC program. If the string is surrounded by double quotes, printing is inhibited for any succeeding string in the program line. If quotes do not surround the string, any consecutive number of spaces in the string are condensed to one space.

EXAMPLE:

```
>10 LPRINT "HELLO" THAT'S ALL
>20 LPRINT HI  I'M  LARRY
>30 LPRINT "I  HAVE  MORE  SPACES"
>RUN
 HELLO                          :words after second quote are omitted
 HI I'M LARRY                   :spaces condensed (no quotes)
 I  HAVE  MORE  SPACES          :spaces not condensed (quotes)
 *DONE*
>
```

MACRO

Set or Display User Macros

MACRO	:Display all currently defined macros
MACRO number	:Display specified macro number
MACRO number/	:Clear specified macro number
MACRO number/string	:Define specified macro number as a string

MACRO displays and defines macros used as an aid in entering commands. A macro is a string of characters that are defined once and recalled using only one or two key strokes. Typically, they are used when a given command may need to be entered many times. **MACRO number** may range from 0–9; **MACRO string** may range from 1 to 80 characters in length.

Macros are recalled by specifying an ampersand (&) followed by the macro number whenever the macro substitution takes place. Note that, although the command **INPUT** is also used to define a macro, it can only be used in a BERD-BASIC program; the **MACRO** command has no such restriction.

See also: **INPUT**

EXAMPLE:

```
>MACRO 1/CLOCK                  :define macro 1 as CLOCK
>MACRO 2/DATE                   :define macro 2 as DATE
>&1                             :display the current time of day
 20:07:13
>&1 21:08                       :set the time ahead one hour (TIME 21:08)
>&2                             :display the current date (DATE)
 15 JAN
>MACRO 2                        :display the contents of MACRO 2
 DATE
>
```

MESSAGES

Enable or Disable Error Message Printing

MESSAGES :Display current status of error message printing
MESSAGES [ON / OFF] :Enable or disable error message printing

MESSAGES controls the printing of error messages at your remote control unit. **MESSAGES ON** enables the printing of error messages when appropriate conditions exist; **MESSAGES OFF** disables the printing of error messages under such conditions.

MESSAGES ON is the default at power-up time.

EXAMPLE:

```
>MESSAGES                    :display current status
 OFF
>MESSAGES ON                 :enable error message printing
>
```

MOD

Transmit and Receive Mode

MOD :Display mode status
MOD (mode) :Select a mode

MOD sets or returns the current transmit and receive line rate and data format. The (**mode**) you select can be one of the following:

T1	:T1 line rate unframed
T1 D4	:T1 rate with D4 framing
T1 ESF	:T1 rate with ESF framing
T1 SLC	:T1 rate with SLC-96 framing
T1C	:T1C line rate
T1C TLB	:T1C rate in Test Loopback mode
T1 TLB	:T1 rate in Test Loopback mode
T1 LLB	:T1 rate in Line Loopback mode
SEL TST	:Self-Test mode using T1 ESF
AUT	:Automatic configuration mode

This command is identical in function to the MODE switch on the T-BERD 209A's front-panel.

EXAMPLE:

```
>MOD                         :display status of mode
 T1 SLC
>MOD T1 ESF                  :set mode to T1 rate with ESF framing
>
```

NEW

Enter a New BERD-BASIC Program

NEW

NEW clears the working memory of any BERD-BASIC program. It is used when entering a new program to ensure that no lines are left from a previous program. When this command is specified, 511 bytes of memory (each byte approximately equivalent to one stored character) are freed for the new program.

EXAMPLE:

```
>10 INPUT 2
>20 DATE
>LIST
>
  10 INPUT 2
  20 DATE
  [493 BYTES FREE]
>NEW                          :purge the existing program
>LIST
>
  [511 BYTES FREE]
```

PARITY

Display Current Parity Setting

PARITY

PARITY is used to obtain the T-BERD 209A's current parity setting. Note that this is an "inquire-only" command; you cannot change the parity setting via remote control.

The PARITY auxiliary function provides parity settings of odd, even, and none. The auto-baud capability sets parity automatically.

EXAMPLE:

```
>PARITY                       :display the current parity setting
  EVEN
>PARITY ODD                   :try to set odd parity
  ERROR: PARITY IS NOT AN EXECUTABLE COMMAND
```

PAT

Set Data Pattern

PAT :Display pattern status
PAT (pattern) :Select data pattern

PAT sets or returns the current data pattern generated by the T-BERD 209A. The (**pattern**) you select can be one of the following.

ALL ONE	:All Marks
1:1	:Alternating Mark and Space
1:7	:One Mark and seven Spaces
3 IN 24	:1000 1000 1000 0000 0000 0000
T1-QRSS	:QRSS pattern (2^{20}-1 with zero suppression)
T1C-QRSS	:2^{20}-1 pseudorandom
2 15-1	:2^{15}-1 bit pseudorandom
2 20-1	:2^{20}-1 bit pseudorandom
2 23-1	:2^{23}-1 bit pseudorandom
pgmpat-name	:User-defined pattern defined in PGMPAT1 or PGMPAT2 (factory defaults are USER1 and USER2, respectively)

This command is identical in function to the PATTERN switch on the T-BERD 209A's front-panel.

See also: **PGMPAT 1** and **PGMPAT 2**

EXAMPLE:

```
>PAT                    :display current pattern
 T1-QRSS
>PAT 2 15-1             :select new pattern
>
```

PGM LPDN

Program Loop-Down Code

PGM LPDN :Display the programmable loop-down code
PGM LPDN (bbbbb..b) :Set programmable loop-down sequence

PGM LPDN allows you to program a loop-down code to be transmitted when you issue **LOO DOW ON** command. The loop-down code sequence is a 3- to 8-bit binary pattern (a sequence of 1s and/or 0s) with the left-most bit transmitted first. The loop-down code sequence is stored in non-volatile memory.

See also: **LOOP CODE**

EXAMPLE:

```
>PGM LPDN               :display current programmable loop-down code
 01001001
>PGM LPDN 100           :set programmable loop-down code to 100
>
```

PGM LPUP

Program Loop-Up Code

PGM LPUP :Display the programmable loop-up code
PGM LPUP (bbbbb..b) :Set programmable loop-up sequence

PGM LPUP programs the loop-up code that is transmitted when a **LOO UP** command is specified. The loop-up code sequence is a 3- to 8-bit binary pattern (a sequence of 1's and/or 0's) with the left-most bit transmitted first. The loop-up code sequence is stored in non-volatile memory.

See also: **LOOP CODE**

EXAMPLE:

```
>PGM LPUP                    :display current programmable loop-up code
 10110110
>PGM LPUP 10000              :set programmable loop-up code to 10000
>
```

PGMPAT 1 AND 2

Programmable Data Pattern

PGMPAT 1 :Display the current programmable data pattern 1
PGMPAT 2 :Display the current programmable data pattern 2
PGMPAT 1 (yyyyyyy,bbb...b) :Set programmable data pattern name and bit sequence

PGMPAT allows you to program two data patterns of your own choosing. The pattern(s) that you define is generated when the pattern name is specified as a PAT command parameter. The **PGMPAT 1** default name is USER1; the default **PGMPAT 1** bit pattern is 1000000 (1:6). The **PGMPAT 2** default name is USER2; the default **PGMPAT 2** bit pattern is 100000 (1:5)

The USER1 and USER2 names can be changed by entering a name with a maximum of seven alphanumeric characters. Specifying a new name is optional when programming a PGMPAT bit sequence; however, if a name is specified, it will appear in the data pattern display window when front-panel control is returned to the T-BERD 209A.

The data pattern can be a 3- to 24-bit binary pattern (a sequence of ones (1) and or zeros (0)); when generated, the left-most bit is transmitted first. The user-defined label and pattern are stored in NOVRAM.

See also: **PAT**

EXAMPLE:

```
>PGMPAT 1                                  :display current PGMPAT 1
 USER1 1000000                             :default name and bit sequence
>PGMPAT 1,TESTIT, 101011100000000111010    :select name and bit sequence
>PGMPAT 1, 11010101110000                  :select bit sequence, retain name
>
```

PRI

Initiate Printout

PRI [CON / RES / SUM] :Select controls or results printout

PRI enables you to initiate a result or controls print. The **PRI CON, PRI RES,** and **PRI SUM** commands generate controls, results, and summary printouts, respectively.

This command is identical in function to the PRINT switch on the T-BERD 209A front-panel (see Switches).

EXAMPLE:

```
>PRI RES                :generate results print
.                       :results print follows
.
.
>PRI CON                :generate controls print
.                       :controls print follows
.
.
>PRI SUM                :generate summary print
.                       :summary print follows
.
.
>
```

PRI EVE

Print Event

PRI EVE :Display the print event status
PRI EVE (event) :Select print event

PRI EVE allows you to determine when (if at all) the T-BERD 209A generates automatic test results prints. The (**event**) choices are:

OFF	:Halt results prints, clear printer FIFO
END TES	:Print at end of test
ERR	:Print on logic, BPV, or frame error
SEV ERR SEC	:Print on severely errored second
2HR	:Print results every two hours
15M	:Print results every 15 minutes
TIM H:MM	:Print results at the time interval specified

Any setting other than **PRI EVE OFF** enables automatic results printouts when one or more alarm conditions change. When specifying **TIM H:MM**, the symbol ":" may be replaced by a dash (-), comma (,), period (.), or slash (/). The valid range for H (hours) is 0-5. The valid range for MM (minutes) is 0-59.

This command is identical in function to the PRINT EVENT switch on the T-BERD 209A front-panel (see Switches), except that **TIM**ed print events are only available in Remote Control mode.

EXAMPLE:

```
>PRI EVE                :display status of print event
 OFF
>PRI EVE 15M            :print results every 15 minutes
>
```

PRI FMT

Results Print Format

PRI FMT :Display current results print format
PRI FMT [NORMAL / SHORT / SUM] :Set new results print format

PRI FMT enables you to choose a results print format. **PRI FMT NORMAL** gives you a printout of all results; **PRI FMT SHORT** gives you only those results which are specifically applicable to the current mode, plus the two results currently displayed on your front panel; **PRI FMT SUM** gives you all results in the SUMMARY category.

EXAMPLE:

```
>PRI FMT                    :display current results print format
 SHORT
>PRI FMT NORMAL             :change the format to NORMAL
>
```

PRINT

Display a Single Result Value

PRINT (result) :Display the specified result value

PRINT displays the value of any T-BERD 209A test result. (**result**) can be specified by name or by number. Unlike the **RES 1** and **RES 2** commands, the T-BERD 209A's front panel does not reflect the result specified.

The valid result names and numbers are listed below.

```
61—ALARMED SEC      :Alarmed second
01—ASYN ER SEC      :Asynchronous Error Seconds
15—%AVLBILITY       :% Availability
00—BIT ERRORS       :Bit errors
04—BIT ERR RT       :Bit error rate
27—BPV RATE         :BPV rate
26—BPV SECONDS      :BPV seconds
65—CLOCK TIME       :Clock time of day
37—CRC ERR RT       :CRC error rate
32—CRC ERRORS       :CRC errors
33—CRC ERR SEC      :CRC errored seconds
36—CRC SES          :CRC severely errored seconds
16—CSES             :Consecutive severely errored seconds
66—DATE             :Date
12—DEGR MIN         :Degraded minutes
13—%DEGR MIN        :% Degraded minutes
63—ELAPSE TIME      :Elapsed time
05—ER FREE SEC      :Error-free seconds
06—%EFS             :% Error-free seconds
47—FALL TIME        :Pulse fall time
```

PRINT (Continued)

30—FRM ERRORS	:Frame errors
31—FRM ER RATE	:Frame error rate
28—FRM ERR SEC	:Frame errored seconds
34—FRM LOS CNT	:Frame loss count
35—FRM LOS SEC	:Frame loss seconds
29—FRM SES	:Frame severely errored seconds
08—OUT SYN SEC	:Out-of-synchronization seconds
49—OVERSHOOT	:Overshoot
44—PULSE SHAPE	:Pulse shape
45—PULSE WIDTH	:Pulse width
46—RISE TIME	:Pulse rise time
40—RX FREQ	:Receive frequency in Hz
42—RX LEVEL DBM	:Receive level in dBm
41—RX LEVEL DSX	:Receive level in dBdsx
43—RX LEVEL vp-p	:Receive level in volts
10—SEV ERR SEC	:Severely errored seconds
11—%SEV ER SEC	:% Severely errored seconds
60—SIG LOS SEC	:Signal loss seconds
53—SLP ANA SEC	:Timing slip analysis seconds
09—SLIPS	:Pattern slips
50—SPX CURRENT	:Simplex current
07—SYN ERR SEC	:Synchronized error seconds
64—TEST END IN	:Time remaining in timed test
62—TEST LENGTH	:Length of a timed test
51—TIMING SLIP	:Controlled timing slips
14—UNAVL SEC	:Unavailable seconds
48—UNDERSHOOT	:Undershoot
25—VIOLATIONS	:Violations
70—WANDER +PK	:Maximum positive wander peak
71—WANDER -PK	:Maximum negative wander peak
72—P-P WANDER	:Peak-to-peak wander
73—15m WANDER	:Maximum peak-to-peak wander over 15 minutes
74—24h WANDER	:Maximum peak-to-peak wander over 24 hours
75—TIE WANDER	:Tie wander

See also: **RES 1 and RES 2**

EXAMPLE:

```
>PRINT SLIPS                    :display number of pattern slips
 SLIPS 23
>
```

PROMPT

Remote Control Command Prompt

PROMPT :Display status of prompt
PROMPT [ON / OFF] :Turn prompt on or off
PROMPT STRING (prompt-string) :Define a prompt

PROMPT controls the prompt symbol at the remote control unit. **PROMPT ON** enables the display of a ''>'' as the prompt symbol when the T-BERD 209A is ready to receive a command. **PROMPT OFF** ''turns off'' the prompt symbol. **PROMPT STRING** allows you to define a prompt symbol (or prompt string) of your own.

Note that the T-BERD 209A changes any current prompt symbol to ''+'' when the **HOLD** command is specified.

EXAMPLE:

```
>PROMPT                    :display prompt status
  ON
>PROMPT STRING =           :define "=" as prompt symbol
=PROMPT OFF                :turn off the "=" prompt
  CLOCK                    :display the time (no prompt)
  10:33:04
  PROMPT ON                :turn on the "=" prompt
=
```

PULSE MASK

Pulse Mask Specification

PULSE MASK :Display current pulse mask specification
PULSE MASK [NI/DSX/NONE] :Set pulse mask specification

PULSE MASK controls the selection of a pulse mask specification. **PULSE MASK NI** selects the pulse mask conforming to the ANSI T1.403 Nework Interface specification; **PULSE MASK DSX** selects the pulse mask conforming to AT&T Compatibility Bulleting 119. **PULSE MASK NONE** indicates that a pulse mask specification is not selected; no mask appears on the pulse shape printout.

This command is identical in function to the PLS MASK auxiliary function.

EXAMPLE;

```
>PULSE MASK                :display current pulse mask specification
  NET INT
>PULSE MASK DSX            :select new pulse mask
>
```

PWR SAVE

Power Save

PWR SAVE	:Display current power save status
PWR SAVE [ON / OFF]	:Set power save status

PWR SAVE saves power by automatically turning off all three T-BERD 209A displays if the instrument has been idle for five consecutive minutes. **PWR SAVE ON** enables the power save feature; **PWR SAVE OFF** disables the power save feature.

Display power is restored when issuing any valid remote control command. Also note that **PWR SAVE** is identical to the PWR SAVE auxiliary function.

NOTE: This command is operational only when the T-BERD 209A's battery option is installed.

EXAMPLE:

```
>PWR SAVE                    :display current power save status
  OFF
>PWR SAVE ON                 :activate power save feature
>
```

REC INP

Receive Input

REC INP	:Display current receive input status
REC INP [BRI / TER / DSX]	:Set the current receive input setting

REC INP selects input impedance and signal conditioning. **REC INP BRI** provides greater than 1000 ohms input impedance for lines already terminated; **REC INP TER** provides 100 ohms impedance; **REC INP DSX** provides both 100 ohms impedance and amplification of the signal.

This command is identical in function to the RECEIVE INPUT switch on the T-BERD 209A's front-panel. Also note that this command causes a test restart.

EXAMPLE:

```
>REC INP                     :display current receive input status
  DSX
>REC INP TER                 :select TERM position
>
```

REL

Release All Printer Output

REL

REL releases all output in the print buffer from HOLD status. When the release command is specified, the prompt character changes from the "+" to the standard ">" (or user-specified prompt) to indicate that printer output is no longer held.

See also: HOLD

EXAMPLE:

```
>HOLD                    :hold all printouts for now . . .
+CLOCK                   : . . . then print the time and date
+DATE                    :(note that nothing is printed)
+REL                     :start printing . . .
>                        : . . . and the prompt changes to ">"
  12:34:56               :The T-BERD 209A prints the time . . .
  14 APR                 : . . . and date
>
```

REM

Remark or Comment

REM

REM is used to place a remark or comment in a BERD-BASIC program. Remarks are nonexecutable, and thus ignored by the T-BERD 209A.

EXAMPLE:

```
>10 LPRINT LOOSE LIPS
>20 REM SHOULD BE TIGHTENED?      :this command is ignored
>30 LPRINT SINK SHIPS
>RUN
  LOOSE LIPS                      :line 20 is non-executable
  SINK SHIPS
>
```

REMOTE

Remote Control Entry

REMOTE

REMOTE places the T-BERD 209A in Remote Control mode from Local or Terminal mode. In Remote Control mode, all front panel switches are inactive (with the exception of the CATEGORY and RESULT switches).

Unlike the **TERMINAL** command, the **REMOTE** command turns prompt and echo off.

See also: **LOCAL, TERMINAL**

EXAMPLE:

```
REMOTE                    :enter Remote Control mode from Local mode
                          :you must enable prompt and echo
```

RES 1 and 2

Result Display Control

RES 1 (result) :Display (result) in Display I
RES 2 (result) :Display (result) in Display II

The **RES 1** and **RES 2** commands control the display results on the front panel of the T-BERD 209A. Unlike the **PRINT** command, the front panel is updated to reflect the result specified; additionally, the value of the specified result is not displayed at the remote control unit. **(result)** can be expressed as a name or number.

The valid result names and numbers are listed below.

61—ALARMED SEC :Alarmed second
01—ASYN ER SEC :Asynchronous Error Seconds
15—%AVLBILITY :% Availability
00—BIT ERRORS :Bit errors
04—BIT ERR RT :Bit error rate
27—BPV RATE :BPV rate
26—BPV SECONDS :BPV seconds
65—CLOCK TIME :Clock time of day
37—CRC ERR RT :CRC error rate
32—CRC ERRORS :CRC errors
33—CRC ERR SEC :CRC errored seconds
36—CRC SES :CRC severely errored seconds
16—CSES :Consecutive severely errored seconds
66—DATE :Date
12—DEGR MIN :Degraded minutes
13—%DEGR MIN :% Degraded minutes
63—ELAPSE TIME :Elapsed time
05—ER FREE SEC :Error-free seconds
06—%EFS :% Error-free seconds
47—FALL TIME :Pulse fall time
30—FRM ERRORS :Frame errors
31—FRM ER RATE :Frame error rate
28—FRM ERR SEC :Frame errored seconds
34—FRM LOS CNT :Frame loss count
35—FRM LOS SEC :Frame loss seconds
29—FRM SES :Frame severely errored seconds
08—OUT SYN SEC :Out-of-synchronization seconds
49—OVERSHOOT :Overshoot
44—PULSE SHAPE :Pulse shape
45—PULSE WIDTH :Pulse width
46—RISE TIME :Pulse rise time
40—RX FREQ :Receive frequency in Hz
42—RX LEVEL DBM :Receive level in dBm
41—RX LEVEL DSX :Receive level in dBdsx
43—RX LEVEL vp-p :Receive level in volts
10—SEV ERR SEC :Severely errored seconds
11—%SEV ER SEC :% Severely errored seconds
60—SIG LOS SEC :Signal loss seconds
53—SLP ANA SEC :Timing slip analysis seconds
09—SLIPS :Pattern slips
50—SPX CURRENT :Simplex current
07—SYN ERR SEC :Synchronized error seconds
64—TEST END IN :Time remaining in timed test
62—TEST LENGTH :Length of a timed test
51—TIMING SLIP :Controlled timing slips
14—UNAVL SEC :Unavailable seconds
48—UNDERSHOOT :Undershoot
25—VIOLATIONS :Violations

RES 1 and 2 (Continued)

70—WANDER +PK	:Maximum positive wander peak
71—WANDER -PK	:Maximum negative wander peak
72—P-P WANDER	:Peak-to-peak wander
73—15m WANDER	:Maximum peak-to-peak wander over 15 minutes
74—24h WANDER	:Maximum peak-to-peak wander over 24 hours
75—TIE WANDER	:Tie wander

See also: **PRINT**

EXAMPLE:

>**RES 1 66**	:display date in Display I
>**RES 2 35**	:display frame loss seconds in Display II
>	

RESPONSE

T-BERD 209A Loop Code Response

RESPONSE :Display current loop code response status
RESPONSE [AUTO / NONE] :Set loop code response

RESPONSE controls how the T-BERD 209A responds to loop codes.

When you specify **RESPONSE AUTO,** the T-BERD 209A responds to loop codes by emulating a CSU. If five seconds of in-band loop-up code are received, the T-BERD 209A automatically enters Line Loopback (AUTO LLB) mode; the instrument repeats all transmitted data until you send a valid loop-down code sequence. After receiving a loop-down code, the T-BERD 209A exits AUTO LLB mode and reenters the mode indicated by the current setting of the MODE switch (or MODE remote control command).

When you specify **RESPONSE NONE,** the T-BERD 209A remains in its current mode when detecting a loop code.

This command is identical to the RESPONSE auxiliary function (see Auxiliary Functions).

EXAMPLE:

```
>RESPONSE                    :display current loop code response status
  NONE
>RESPONSE AUTO               :set automatic loop code response
>
```

RESTART

Test Restart

RESTART

RESTART restarts the T-BERD 209A test. This command is identical in function to the RESTART switch on the T-BERD 209A front panel (see Switches).

EXAMPLE:

```
>RESTART                     :restart test
>
```

RESULTS

Generate a Results Printout

RESULTS

RESULTS allows you to initiate a printout of all current T-BERD 209A test results. This command is functionally identical to pressing the RESULTS position of the PRINT switch on the T-BERD 209A's front panel.

The effect of this command is identical to issuing the PRI RES remote control command.

EXAMPLE:

```
>RESULTS                    :generate a results print
.                           :results print follows
.
.
>                           :results print ends
```

RUN

Execute a BERD-BASIC Program

RUN :Execute a BERD-BASIC program
RUN linenumber :Execute a BERD-BASIC program beginning at specified **linenumber**

RUN executes the current BERD-BASIC program. Unless the **linenumber** parameter is specified, execution starts at the first line of the program.

EXAMPLE:

```
>10 LPRINT FRANKLIN
>20 LPRINT DELANO
>30 LPRINT ROOSEVELT
>RUN 30                     :run starting at line 30
 ROOSEVELT                  :only line 30 is executed
>RUN                        :run entire program
 FRANKLIN
 DELANO
 ROOSEVELT
>
```

STOP

Suspend Execution of a BERD-BASIC Program

STOP

STOP suspends the execution of a running BERD-BASIC program; execution of a BERD-BASIC program is resumed by issuing the **CONT** command. Note that the **STOP** command is a BERD-BASIC command only.

Program execution cannot be resumed if any existing line in a program has been changed, or if a program has reached its conclusion.

See also: **CONT**

EXAMPLE:

```
>10 LPRINT "FIRST HALF"          :this program runs in two halves . . .
>20 STOP                         : . . . with a STOP in the middle
>30 LPRINT "SECOND HALF"
>40 END
>RUN                             :run the program
  FIRST HALF                     :the program stops running . . .
  BREAK IN LINE 20               : . . . due to the STOP command
>CONT                            :continue running the program
  SECOND HALF
  *DONE*                         :the program is finished running
>
```

SUMMARY

Generate a Summary Printout

SUMMARY

SUMMARY allows you to initiate a printout of all summary test results. The effect of this command is identical to issuing the PRI SUM remote control command.

EXAMPLE:

```
>SUMMARY                         :generate a summary print
  .                              :summary print follows
  .
  .
>                                :summary print ends
```

SYN LOS ACT

Action on Synchronization Loss

SYN LOS ACT	:Display current mode status
SYN LOS ACT [CONT / HALT]	:Set mode of synchronization loss

SYN LOS ACT controls the T-BERD 209A's reaction to synchronization loss. **SYN LOS ACT CONT** causes all test results to accumulate continuously throughout a loss of synchronization. **SYN LOS ACT HALT** halts test results during a loss of synchronization. This command is identical in function to the HLT/CONT auxiliary function (see Auxiliary Functions).

EXAMPLE:

>**SYN LOS ACT**	:display current action on synchronization loss
HALT	:the T-BERD 209A is in HALT mode
>**SYN LOS ACT CONT**	:set action on sync loss to CONT
>	

TERM 232

Remote Control Line Terminator

TERM 232	:Display current line terminator setting
TERM 232 [CR / CRLF]	:Set the line terminator

TERM 232 controls RS-232 line termination on a printer or remote control unit. When you specify **TERM 232 CR**, a carriage return is transmitted at the end of each displayed line; when you specify **TERM 232 CRLF**, each displayed line is followed by a carriage return and a line feed.

This command is identical to the TERM auxiliary function (see Auxiliary Functions).

EXAMPLE:

>**TERM 232**	:display the current line terminator
CRLF	
>**TERM 232 CR**	:select carriage return as line terminator
>	

TERMINAL

Configure the T-BERD 209A for Remote Control Operation

TERMINAL
. (period) :Alternate form of the **TERMINAL** command

TERMINAL configures the T-BERD 209A for remote control operation by automatically setting the following:

```
ECHO ON        :turn echo on
PROMPT ON      :turn command prompts on
WIDTH 80       :printer width 80 columns
TERM CRLF      :line terminator of carriage return and line feed
```

This command is typically used as a log-in sequence just after the T-BERD 209A is powered up. You need only type a period (.) to get the T-BERD 209A's attention, enter Terminal mode, and have the default prompt (>) printed on the screen.

When the TERMINAL command is specified, all front-panel switches (except the CATEGORY and RESULT switches) are inactive.

See also: **LOCAL REMOTE**

EXAMPLE:

```
                    :assume that you have just powered up the T-BERD 209A; you have just typed a
                    period (.) which the T-BERD 209A does not echo.
>                   :the T-BERD 209A responds with a prompt and is now in Terminal mode.
```

TEST

Test Results Accumulation

TEST :Display the current test duration criteria
TEST [TIMED / CONT] :Set the test duration criteria

TEST enables you to specify how test results are accumulated. When you specify **TEST TIMED**, the T-BERD 209A accumulates test results for the duration specified in the TEST LEN auxiliary function or TIM SET remote control command. When you specify **TEST CONT**, the T-BERD 209A accumulates test results continuously.

This command is equivalent to the TEST switch located on the T-BERD 209A's front panel.

EXAMPLE:

```
>TEST               :Display the current test duration
  CONT
>TEST TIMED         :Select a single timed test
>
```

TIM

Transmit Timing Source

TIM	:Display the current transmit timing source
TIM [EXT / INT / REC]	:Set the transmit timing source

TIM controls the selection of a timing source. **TIM EXT** sets transmit timing to an external clock source; **TIM INT** sets transmit timing to the T-BERD 209A's internal clock source; **TIM REC** sets the transmit timing source to the clock signal recovered from the received data. This command is identical in function to the TIMING switch on the T-BERD 209A front panel (see Switches).

EXAMPLE:

>**TIM**	:display the transmit timing source
INT	:transmit timing source is INTERNAL
>**TIM REC**	:change transmit timing source to
>	RECOVERED

TIM SET

Test Length

TIM SET	:Display the current test length setting
TIM SET HHH:MM:SS	:Set new test length

TIM SET controls the length of a timed test. The parameter **HHH:MM:SS** is given in hours, minutes, and seconds, respectively; each can be specified separately (HHH, MM, or SS). When setting a new test length, the symbol ":" may be replaced by a dash (-), comma (,), period (.), semicolon (;), or slash (/). The valid ranges for each time value are:

HHH:	0–200 hours
MM:	0–59 minutes
SS:	0–59 seconds

This command is identical to the TEST LEN auxiliary function (see Auxiliary Functions).

See also: **TEST**

EXAMPLE:

>**TIM SET**	:display the current test length setting
12:35:00	:current test length is 12 hrs. 35 min.
>**TIM SET ; 6 ;**	:set test length of six minutes
>**TIM SET**	
06:00:00	:test length now is 6 minutes

TRA OUT

Transmit Output

TRA OUT :Display current transmit output status
TRA OUT [−7.5 / 0 / −15] :Select transmit output setting

TRA OUT controls the current transmit output setting, allowing you to select emulation of three different cable losses for T1 rates. Selectable line buildout includes **−7.5** dB, **0** dB, and **−15** dB.

EXAMPLE:

```
>TRA OUT                    :display current transmit output status
 −7.5 (dB)
>TRA OUT -15                :select −15 dB position
>
```

UNFORMAT

Unformatted Printouts

UNFORMAT

UNFORMAT suppresses the printing of blanks between words in printed output. The alternative is **FORMAT**, which makes printouts easier to read.

See also: **FORMAT**

EXAMPLE 1:

```
>10 FORMAT                  :set formatted print
>20 LPRINT THERE ARE BLANKS
>RUN
 THERE ARE BLANKS           :formatted print from line 20
```

EXAMPLE 2:

```
>10 UNFORMAT                :set unformatted print
>20 LPRINT THERE ARE NO BLANKS
>RUN
 THEREARENOBLANKS           :unformatted print from line 20
>
```

6. MAINTENANCE AND SERVICE

6.01 This section contains information on T-BERD 209A maintenance and service. Specifically, it describes the steps to take should you experience difficulty operating the T-BERD 209A. Instructions for replacing the instrument's AC line fuse are also available, as is a description of TTC's warranty and repair procedures.

In Case of Difficulty

6.02 If the T-BERD 209A fails to operate and no front panel indicators are illuminated:

(1) Check the AC power cord to ensure that it is securely connected to the T-BERD 209A.

(2) Make sure that the power supply is uninterrupted by plugging another electrical device into the electrical outlet used by the T-BERD 209A.

(3) Verify that a proper, working AC line fuse is installed. Information on the type of fuse and its installation is given in AC Line Fuse.

6.03 If the T-BERD 209A fails to operate after the AC power cord, power supply, and fuse are found to be in proper working order, contact the TTC Customer Service Department (1-800-638-2049). If front-panel indicators are illuminated, but the instrument does not operate properly:

(1) Use the Instrument Checkout Procedure in Section 3 to localize the problem.

(2) Note those areas in which the self-test failed, then contact TTC for assistance.

AC Line Fuse

6.04 The T-BERD 209A's AC line fuse is stored in the AC fuse receptacle located just underneath the POWER switch. If faulty, the fuse should be replaced with a 1A 250-volt, SLO-BLO fuse (Littlefuse #218001 or equivalent). Always use the correct fuse size.

6.05 To replace the AC line fuse, do the following:

(1) Locate the tab to the plastic fuse cover above the T-BERD 209A's POWER switch receptacle.

(2) Using a small screwdriver or similar instrument, gently pry the fuse cover open.

(3) Remove the old fuse and install new fuse of the correct size.

(4) Press the plastic fuse holder securely back into place.

Auto-Calibration

6.06 The T-BERD 209A features an auto-calibration function that allows you to automatically adjust receive level measurement, recovered clock extraction, T1/T1C detectors, and simplex current measurements. It is suggested that auto-calibration be performed once a year to compensate for the normal aging of components.

6.07 Auto-calibration is performed by simultaneously pressing the DISPLAY HOLD switch and applying power to the T-BERD 209A. Keep the DISPLAY HOLD switch depressed until the message **CALIBRATING** appears in the display.

NOTE: Auto-calibration should be performed after allowing the unit to warm up at normal room temperature for a period of 30 minutes.

6.08 If an error occurs during auto-calibration, an error message appears in the display; in such instances, call TTC's customer service department for assistance.

Service

A. Warranty Policy

6.09 All equipment manufactured by Telecommunications Techniques Corporation (TTC) is warranted against defects in material and workmanship. This warranty applies only to the original purchaser and is non-transferable unless express written authorization of the warranty transfer is granted by TTC.

6.10 The T-BERD 209A will be repaired or replaced (at our option) at no charge for a period of three (3) years after shipment to the customer. Liability under this warranty extends only to the replacement value of the equipment. The warranty is void under the following conditions.

(1) Equipment has been altered or repaired without specific authorization from TTC.

(2) Equipment is installed or operated other than in accordance with instructions contained in TTC literature and operating manuals.

6.11 No other warranty is expressed or implied. TTC is not liable for consequential damages.

B. In-Warranty Service

6.12 Equipment in warranty must be returned to the factory with shipping prepaid. The equipment should be packed and shipped in accordance with instructions in Equipment Return Instructions of this manual. Before returning any equipment, the customer must obtain a Return Authorization (RA) number by contacting the TTC Repair Department. The RA number should then appear on all paperwork and be clearly marked on the outside of the shipping container.

6.13 After the equipment is repaired by TTC, it will be tested to applicable specifications, burned-in for at least 24 hours, retested, and returned to the customer with shipping prepaid. A brief description of the work performed and the materials used will be provided on the Equipment Repair Report furnished with the returned equipment.

C. Out-of-Warranty Service

6.14 The procedure for repairing out-of-warranty equipment is the same as that used for equipment still in warranty. However, there is a minimum charge applied to each request for out-of-warranty service. The minimum charge guarantees the customer an estimate of the repair costs and is used as credit against actual materials and labor costs should the equipment be repaired. Contact the TTC Repair Department for specific information on the minimum out-of warranty repair charge.

6.15 The customer will be billed for parts plus standard labor rates in effect at the time of the repair. The customer will also be required to furnish a purchase order number before repair work can be started, and a hard copy of the purchase order must be received by TTC before the repaired equipment may be shipped to the customer. A description of the labor and materials used will be provided in the Equipment Repair Report.

6.16 Once an out-of-warranty repair is made, the repaired part or component is warranted for 90 days. This warranty applies only to the part or component that was repaired; other parts or components are not covered under the 90-day repair warranty.

D. Equipment Return Instructions

6.17 To all equipment returned for repair, the customer should attach a tag that includes the following information.

(1) Owner's name and address.

(2) A list of the equipment being returned and the applicable serial number(s).

(3) A detailed description of the problem or service requested.

(4) The name and telephone number of the person to contact regarding questions about the repair.

(5) The Return Authorization (RA) number.

6.18 If possible, the customer should return the equipment using the original shipping container and material. If the original container is not available, the unit should be carefully packed so that it will not be damaged in transit. TTC is not liable for any damage that may occur during shipping. The customer should clearly mark the TTC-issued RA number on the outside of the package and ship it prepaid and insured to TTC.

7. SPECIFICATIONS

7.01 This section contains the specifications for the T-BERD 209A T-Carrier Analyzer.

General Specifications

A. Physical

- Size: 6″H x 13.5″W x 8.5″D (15.3 cm x 34.4 cm x 16.5 cm) including cover.
- Weight: 14.8 pounds (6.7 kg) with battery, 10 pounds (4.5 kg) without battery.

B. Operational

- Operating Temperature Range: 32°F to 113°F (0°C to 45°C).
- Storage Temperature Range: −4°F to 158°F (−20°C to 70°C).
- Power: 50/60 Hz, 115 VAC ±10% or 230 VAC (factory option).
- Battery (optional): Four hour life, 14 hour nominal charging time.
- Fuse: 1A, 250V SLO-BLO; (Littlefuse #218001 or equivalent).

Input Specifications

A. Receive Input

- Input Connectors: WECo 310 jack, bantam jack, and 15-pin network interface D connector.
- Input Frequency: T1—1544000 Hz ± 5000 Hz.
  T1C—3152000 Hz ± 5000 Hz.
- Input Impedance: BRIDGE—1000 ohms or greater.
  TERM—100 ohms ±5%.
  DSX-MON—100 ohms ±5%.
- Operating Range: BRIDGE—+6 dBdsx to −35 dBdsx for T1, +3 dBdsx to −6 dBdsx for T1C. Automatic line buildout compensates for cable loss characteristics.
  TERM—+6 dBdsx to −35 dBdsx for T1, +3 dBdsx to −6 dBdsx for T1C. Automatic line buildout compensates for cable loss characteristics.
  DSX-MON—+3 dBdsx to -24 dBdsx for T1C. No automatic line buildout provided; resistive loss compensation only.

B. T1 Reference Input

- Input Connectors: WECo 310 jack and bantam jack.
- Input Frequency: 1544000 ± 1000 hz.
- Input Impedance: 100 ohms ±5%.
- Operating Range: +6 to −24 dBdsx resistive loss.

Output Specifications

- Output Connectors: Selectable line buildout in T1 of 0 dB, −7.5 dB, and −15 dB is provided on WECo 310 jack, bantam jack, and 15-pin network interface D connector. Three additional DSX-level 310 jack outputs are provided.
- Output Line Buildout Tolerance: ±1 dB attenuation at 772 kHz.
- Pulse Shape: With output terminated in 100 ohm resistive load and 0 dB line buildout selected, the T-BERD 209A meets pulse shape specifications given in CCITT Recommendation G.703; Bell Publications CB113, CB119, CB132, and CB143; and AT&T PUB62508, and AT&T PUB62411.
- Internal Oscillator Accuracy: ±5 ppm.
- Jitter Attenuation: Per Figure A-5 of AT&T PUB62411, October 1985 Revision.
- Line Codes: Bipolar (pseudoternary); switch-selectable AMI or B8ZS.

Front Panel

A. Switches

- Modes: AUTO, T1, T1 D4, T1 ESF, T1 SLC, T1C, T1C TLB, T1 TLB, T1 LLB, SELF TST, AUX.
- Patterns: Fixed—ALL ONES, 1:1, 1:7, 3 IN 24, two user-programmable 3- to 24-bit repeating patterns.
  Pseudorandom—T1-QRSS, T1C-QRSS, 2^{15}-1, 2^{20}-1, 2^{23}-1.
- Results: SUMMARY—Bit errors, slips (pattern), violations (BPVs), frame errors, CRC errors, frame loss count, receive frequency, pulse shape, timing slips. (See Table 32 for non-zero and out-of-specification display criteria.)
  LOGIC—Bit errors, asynchronous errored seconds, bit error rate, error-free seconds, percent error-free seconds, synchronized errored seconds, out-of-synchronization seconds, and pattern slips.
  BPV & FRAME—Violations, BPV seconds, BPV rate, frame error seconds, frame severely errored seconds, frame errors, frame error rate, CRC errors, CRC errored seconds, frame loss count, frame loss seconds, CRC severely errored seconds, and CRC error rate.

Table 32—Display Criteria for Summary Results

RESULT:	DISPLAY CRITERIA:
Bit Errors	>0
Slips	>0
Violations	>0
Frame Errors	>0
CRC Errors	>0
Frame Loss Count	>0
Receive Frequency	T1: Outside the range 1543923-1544077 Hz.
	T1C: Outside the range 3151906-3152094 Hz.
Pulse Shape	Failure to meet selected mask criteria.
Timing Slips	Not equal to 0.

SIGNAL—Received frequency (Hz), received level (dBdsx), received level (dBm), received level (V p-p), pulse shape (pass/fail), pulse width, rise time, fall time, undershoot, overshoot, simplex current, timing slip, and slip analysis seconds.

TIME—Signal loss seconds, alarmed seconds, test length, elapsed time, test end in, clock time, and date.

WANDER—Maximum positive peak wander deviation, maximum negative peak wander deviation, total positive-to-negative peak wander deviation, 15-minute wander, 24-hour wander, and TIE wander.

Performance Analysis Option (LOGIC Category)—Severely errored seconds, percent severely errored seconds, degraded minutes, percent degraded minutes, unavailable seconds, percent availability, consecutive severely errored seconds.

- Test Lengths: Timed or continuous.
- Timed Test Length: 15 seconds to 200 hours, 59 minutes. Factory setting is 200 hours.
- Transmit Timing Selection: External (from BNC or T1 REF), internal, and recovered.
- Transmit Codes: AMI, B8ZS.
- Error Insert: BPV—single, rate, or burst. Rate can be specified within range 1.0 E-2 to 1.0 E-9. End result burst length can be specified within the range 25 ms. to 5 seconds.

  Logic—single, rate, or burst. Rate can be specified within range 1.0 E-2 to 1.0 E-9. Burst length can be specified within the range 25 ms. to five seconds.

  Frame—single, consecutive, or per superframe error insertion (consecutive range: 2-6). Error insertion on Ft bits (for D4 or SLC-96 framing) or FPS bits (for ESF framing).
- Receive Input: Bridge, Terminate, DSX-Monitor.
- Transmit Output Level: 0 dB, −7.5 dB, −15 dB.

B. Indicators

- Alarm Indicators: Signal Loss, Signal Loss History, Pattern Loss, Pattern Loss History, Frame Loss, Frame Loss History, Ones Density, Ones Density History, Excess Zeros, Excess Zeros History, Yellow Alarm, Yellow Alarm History, All Ones, All Ones History, Pulse Shape, Pulse Shape History, Low Battery, Low Battery History, Power Loss History.
- Loop Code Indicators: Loop Up Detect, Loop Down Detect, Pre-Existing Loop, Loop Up Send, Loop Down Send.
- Error Insert Indicators: Frame Error Insert, BPV Error Insert, Logic Error Insert.
- Status Indicators: T1 Pulses, T1C Pulses, Frame Sync, Pattern Sync, B8ZS Detect.

C. Alarm Criteria

- Signal Loss: 150 milliseconds without input pulses after valid frequency and level are detected.
- Pattern Sync Loss: 250 errors detected in 1000 or fewer bits.
- Frame Sync Loss: D4—2 out of 5 Ft bits in error.
  ESF—2 out of 5 frame bits in error.
  SLC—2 out of 5 Ft bits in error.
- Excess Zeros: 16 or more consecutive zeros in T1; 34 or more consecutive zeros in T1C.
- Yellow Alarm: D4—Bit 2 is a 0 for 255 consecutive channels.
  ESF—256 bits ±16 bits of a repetitive "1111111100000000" pattern received in the 4 kb/s data link.
  SLC—Bit 2 is a 0 for 255 consecutive channels.
- All Ones: 2048 consecutive ones in unframed T1 or T1C signals; 256 consecutive DSO channels with all ones for T1 framed modes.
- Ones Density: Less than 12.5% ones density during measurement interval per compatibility bulletin 119, or per AT&T Technical Reference PUB62411. This indicator is disabled when receiving a T1-QRSS pattern or any T1C signal.

- Pulse Shape: Received pulse does not fit within the selected mask.
- Low Battery (Optional): Approximately 15 minutes of battery life remaining.

Pattern Specifications

A. Pattern Definition

- ALL ONES: All Marks.
- 1:1: Alternating Mark and Space.
- 1:7: One Mark and seven Spaces.
- 3 IN 24: 01 0001 0000000000000001 00.
- T1-QRSS: QRSS pattern (220-1 with zero suppression).
- 2^{15}-1: 2^{15}-1 bit pseudorandom.
- 2^{20}-1/T1C-QRSS: 2^{20}-1 bit pseudorandom.
- 2^{23}-1: 2^{23}-1 bit pseudorandom.
- pgmpat-name: User-defined patterns; factory setting for USER1 is 1:6; factory setting for USER2 is 1:7.

B. Pattern Sync Detection Criteria

- Fixed Patterns: 30 consecutive error-free bits.
- Pseudorandom Patterns: 30 + n consecutive error-free bits for a pattern length of 2^n-1. For QRSS, n = 20.

Loop Codes

A. Generation and Detection Patterns

- Loop-Code Generation Patterns: CSU (loop-up code: 10000; loop-down code: 100); facility loop code 1 (loop-up code: 1100; loop-down code: 1110); facility loop code 2 (loop-up code: 11000; loop-down code: 11100). The generated codes may be sent unframed or framed. When framing is selected, loop codes are overwritten by the framing bit.
- Programmable Loop Codes: 3- to 8-bit repeating code independently settable for loop-up and loop-down codes. Factory setting for loop-up code: repetitive 10000 (CSU loop-up); factory setting for loop-down code: repetitive 100 (CSU loop-down).

B. Loop Detect Criteria

- Loop-Up: At least 185 error-free bits of the selected pattern must be received.
- Loop-Down: At least 185 error-free bits of the selected pattern must be received.

Measurements

A. Frequency

- Accuracy: ±5 ppm.
- Resolution: 1 Hz.
- T1 Range: 1544000 Hz ± 5000 Hz.
- T1C Range: 3152000 Hz ± 5000 Hz.

B. Level

7.02 The designation dBdsx is a voltage measurement; a 3-volt base-to-peak signal is defined as 0 dBdsx. Measurements for dBm are available only when all ones is detected.

- dBdsx Level Range: +6 dBdsx to −40 dBdsx.
- dBdsx Level Accuracy: ±1 dB between +6 dBdsx and −10 dBdsx; ±2 dB between −10 dBdsx and −20 dBdsx; ±3 dB between −20 dBdsx and −40 dBdsx.
- dBdsx Resolution: 0.1 dB between +6 dBdsx and −6 dBdsx; 0.5 dB between −6 dBdsx and −40 dBdsx.
- dBm Level Range: +22.5 dBm to −23.5 dBm.
- dBm Level Accuracy: ±5%.
- dBm Resolution: 0.1 dB between +22.5 dBm and +10.5 dBm; 0.5 dB between +10.5 dBm and −23.5 dB.
- V p-p Range: +12.0 V p-p to 60 mV p-p.

C. Simplex Current

- Range: 10 mA to 180 mA.
- Resolution: 1 mA.
- Accuracy: ±5%.
- Simplex Voltage Drop: 8.5 volts (nominal) at 60 mA.

D. Pulse Shape

- Resolution: Amplitude: 8%.
  Sample Interval: 2.75 ns.
- Availability: +4 to −4 for TERM & BRIDGE.
  −16 to −24 for DSXMON.
- Pulse Width: Accuracy: ±5%.
  Resolution: 2.75 ns.
  Rise Time Resolution: 10 ns.
  Fall Time Resolution: 10 ns.
  Undershoot Resolution: 1%.
  Overshoot Resolution: 1%.

E. Timing Slips

- Resolution: 1 frame slip.
- Range: 9999 frame slips.
- Bar Graph Resolution: 16 bit slips.
- Bar Graph Range: ±192 bit slips.
- Wheel Resolution: 1 bit slip.
- Wheel Range: ±16 bit slips.
- Printout Resolution: 1 frame slip.
- Timing Slip Printout Range: 9999 frame slips.
- Bit Slip Printout Resolution: 1 bit slip.
- Bit Slip Printout Range: ±192 bit slips.
- Slip Analysis Seconds Resolution: 1 second.
- Slip Analysis Seconds Range: 99999999 seconds.

F. Wander

- Resolution: 1 UI.
- Accuracy: 1 UI.

Connectors

A. External BNC

- Input Configuration: AC-coupled. Outer conductor is signal ground; inner conductor is signal.
- AC Input Impedance: 50 ohms ±10%.
- Sine-Wave Clock Waveform: 5 volts peak-to-peak minimum; 10 volts peak-to-peak maximum; 1.0 MHz minimum, 4.0 MHz maximum.
- Square-Wave Clock Waveform: 1 volt peak-to-peak minimum; 20 volts peak-to-peak maximum; 1.0 MHz minimum, 4.0 MHz maximum.

B. Front Panel 15-Pin D

- Connector Pin Configuration: See Table 33.

C. Optional RS-232 25-Pin D Connector

- Character Format: 7 or 8 data bits (ASCII coding).
  Even, odd, or no parity.
  2 transmitted stop bits.
  Accepts 1 or more received stop bits.
- Baud Rates: 300, 1200, 2400, 4800. (110, 600, 9600, and 19200 baud rates are available in AUTO-BAUD mode only.)
- Terminator: CR, CRLF.
- Print Width: 80-column.
- Connector Configuration: DCE.
- Connector Pin Configuration: See Table 34.

Table 33—Front Panel Connector Pin Configuration

PIN NUMBER	NAME
1	TRANSMIT TIP
2, 4, 12	SIGNAL GROUND
3	RECEIVE TIP
5, 6, 7, 8, 10	NO CONNECTION
9	TRANSMIT RING
11	RECEIVE RING
13	RESERVED FOR FUTURE USE
14	RESERVED FOR FUTURE USE

Table 34—RS-232 Pin Configuration

SIGNAL	COMMENT
PROT GND (Pin 1):	Connected to chassis ground.
TX DATA (Pin 2):	The T-BERD 209A receives data on this lead.
RCV DATA (Pin 3):	Data is transmitted by the T-BERD 209A on this lead.
CTS (Pin 5):	This lead is driven to the ON state by the T-BERD 209A whenever it is ready to receive a command. This lead may be ignored by the controller if, before issuing commands, it waits for the return of a prompt character from the T-BERD signifying the completion of the previous command.
DSR (Pin 6):	This lead is driven to the ON state by the T-BERD 209A whenever it has power applied.
SIGNAL GROUND (Pin 7):	Connected to signal ground.
RLSD (Pin 8):	This lead is driven to the ON state by the T-BERD 209A whenever it has power applied.
+12 (Pin 9) and −12 (Pin 10):	These leads provide +12 (RS-232 ON) and −12 (RS-232 OFF) respectively, for use in strapping signaling leads ON and OFF.
DTR (Pin 20):	Data is only output from the T-BERD 209A when this line is held in the ON condition by the receiving device.

Grounding

- Chassis and signal grounds isolated by 100 ohm, ½ watt resistor.
- Bantam and 310 jack sleeves connected to chassis ground.
- Power cord center ground pin connected to chassis ground.
- 25-pin D connector: Pin 1 to chassis ground.
  Pin 7 to signal ground.
- 15-pin D connector: Pins 2, 4, and 12 to signal ground.

8. OPTIONS AND ACCESSORIES

8.01 This section describes the various options and accessories that are available for use with the T-BERD 209A.

Options

A. Performance Analysis Option

8.02 The Performance Analysis Option (Option 001) is a factory-installed package which offers you test results based on CCITT Recommendation G.821. The results that are available are:

(1) Unavailable seconds

(2) Percent availability

(3) Degraded minutes

(4) Percent degraded minutes

(5) Severely errored seconds

(6) Percent severely errored seconds

8.03 These results are discussed in more detail in the following paragraphs. Appendix A provides a general discussion of the CCITT specifications.

B. Unavailable Seconds

8.04 The Performance Analysis option splits total test time into two parts:

(1) Time for which the connection is deemed available.

(2) Time for which the connection is deemed unavailable.

8.05 The *available seconds* period starts at the beginning of the test; the period terminates when the bit error ratio (BER) in each second is greater than 1 x 10^{-3} for a period of 10 consecutive seconds. These 10 consecutive seconds are considered to be *unavailable seconds*.

8.06 During available time, the detection of the 10th consecutive severely errored second causes the count of unavailable seconds to be incremented by 10 and the number of available seconds to be decremented by 10. The period of unavailable time continues until 10 consecutive seconds with a BER above 1 x 10^{-3} are detected. These 10 consecutive seconds are then considered to be a part of available time. Upon the detection of the 10th consecutive second, the number of available seconds increases by 10; the unavailable seconds count decreases by 10. Note that a signal loss second and a pattern synchronization loss second are each considered to be a second with a BER worse than 1 x 10^{-3}.

C. Percent Availability

8.07 The percent availability result is the ratio of the number of available seconds to the number of total test seconds, expressed as a percentage. Available seconds are measured in the same manner as the unavailable seconds result. Percent availability decreases when a period of unavailable time begins. If no unavailable seconds are counted during a test, the percent availability is 100.00%; if all test seconds are unavailable seconds, the result is 0.00%. Once unavailable seconds are detected, the highest possible value for percent availability 99.99%. At the lower end of the scale, if at least one available second is counted, the minimum value is 0.01%. For all values of percent availability, the result format is XX.YY%.

D. Degraded Minutes

8.08 The degraded minutes result is the number of minutes during which the bit error ratio is worse than 1 x 10^{-6} but better than 1 x 10^{-3}. The one-minute intervals are derived by removing unavailable seconds and severely errored seconds from the total test time and then consecutively grouping the remaining seconds into blocks of 60.

E. Percent Degraded Minutes

8.09 The percent degraded minutes result is the ratio of degraded minutes to the number of available minutes, expressed as a percentage. If no degraded minutes are counted during a test, the percent degraded minutes result is 0.00%; if all test minutes are degraded minutes, the result is 100.00%. Once non-degraded minutes are detected, the highest possible value for percent degraded minutes is 99.99%. At the lower end of the scale, if at least one degraded minute is counted, the minimum value is 0.01%. For all values of percent degraded minutes, the result format is XX.YY%.

F. Severely Errored Seconds

8.10 The severely errored seconds result reflects a count of the number of seconds during which a bit error ratio

below 1 x 10^{-3} occurs within the available time. Signal loss seconds and pattern synchronization loss seconds are considered as seconds with a bit error ratio below 1 x 10^{-3}. When unavailable time is declared, 10 seconds are subtracted from the severely errored seconds count.

G. Percent Severely Errored Seconds

8.11 The percent severely errored seconds result is the ratio of severely errored seconds to the number of available seconds expressed as a percentage. If no severely errored seconds are counted during a test, the percent severely errored seconds result is 0.00%; if all test seconds are severely errored seconds, the result is 100.00%. Once a non-severely errored second has been detected, the highest possible value for percent severely errored seconds is 99.99%. At the lower end of the scale, if at least one severely errored second is counted, the minimum value is 0.00%. For all values of percent severely errored seconds, the result format is XX.YY%.

Battery Options

8.12 A Gelled Electrolyte Battery option provides up to four hours of continuous, cord-free operation of the T-BERD 209A; no extension cords or generators are required.

8.13 When installed, the battery automatically recharges when the T-BERD 209A is plugged into an AC power outlet. To conserve power, the front-panel displays turn off when no switches are pressed for five consecutive minutes; this feature can be disabled using the appropriate auxiliary function.

Accessories

8.14 Various accessories are offered with the T-BERD 209A; these accessories are described in the following paragraphs. Contact TTC's Customer Service Department for ordering information.

A. 19″ and 23″ Rack Mounts (Models 10958-01 and 10959-01)

8.15 The Rack Mount allows the T-BERD 209A to be mounted in a 19″ or 23″ equipment rack. The assembly requires 7″ of vertical rack space. To install the T-BERD 209A in the rack mount, do the following:

(1) Loosen (but do not remove) the four #6 screws that secure the rack mount's rear bracket to the rack mount tray. Slide the rear bracket to the back of the rack mount tray.

(2) Remove the T-BERD 209A's front cover. It is not necessary to remove the instrument's feet or handles.

(3) Lower the T-BERD 209A through the top of the rack mount until it sits on the rack mount tray. Slide the instrument forward so that its front panel (including the handles) protrudes through the opening in the front of the rack mount. The strikes on the sides of the T-BERD prevent it from being pulled through the opening. Ensure that the pull-out reference card is accessible and that it may be hinged down over the edge of the rack mount.

(4) Once the T-BERD 209A is properly seated in the rack mount, slide the rack mount's rear bracket firmly against the instrument so that the T-BERD's four rear feet protrude through the designated holes in the bracket.

(5) Tighten the four #6 screws that were loosened in Step 1 to secure the T-BERD 209A in the rack mount.

B. Cables

8.16 The following is a list of the accessory cables that are available from TTC for use with the T-BERD 209A.

MODEL	DESCRIPTION
10199	15-pin D to 15-pin D (10')
10420	310 plug to 310 plug (10')
10558	310 plug to alligator clips (10')
10559	310 plug to bantam plug (10')
10615	Bantam plug to bantam plug (10')
10648	Bantam plug to alligator clips (10')
10686	15-pin D to RJ45 (10')

C. T1 Channel Monitor (Model 40849)

8.17 The T1 Channel Monitor (Model 40849) adds VF monitoring capability to the T-BERD 209A, thus giving you the ability to troubleshoot T1 circuits and individual channels within a single test set.

8.18 When purchased, the T1 Channel Monitor replaces the T-BERD 209A's standard lid. Appendix C contains a complete description of this option.

APPENDIX A
DISCUSSION OF G.821

This appendix discusses the concept of available time versus unavailable time as specified in CCITT Recommendation G.821. This discussion is provided to familiarize users with the results that may be obtained with the optional Performance Analysis Package.

CCITT Recommendation G.821 defines available and unavailable time as follows:

> "A period of unavailable time begins when the bit error rate (BER) in each second is worse than 10^{-3} for a period of 10 consecutive seconds. These 10 seconds are considered to be unavailable time. The period of unavailable time terminates when the BER in each second is better than 10^{-3} for a period of 10 consecutive seconds. These 10 seconds are considered to be available time."

Available and unavailable time are measured in seconds—available seconds and unavailable seconds, respectively.

All test seconds must fall into one of the two categories (total available seconds + total unavailable seconds = total test seconds).

At the beginning of a test, test seconds are considered to be available time; the available seconds begin counting. These seconds continue to be counted until 10 consecutive seconds occur each with a BER worse than 10^{-3}. A sliding window, 10 seconds in length, is used to detect this transition from available to unavailable time and vice versa.

As an example, assume a test begins and continues to run for 25 seconds and each of those 25 seconds has a BER better than 10^{-3}. When the test starts, test seconds are considered to be available time, so the available seconds count at this point is 25. In the 26th second, the BER becomes worse than 10^{-3}. The same for the 27th and 28th seconds. In the 29th second, the BER drops back to better than 10^{-3}. All 29 seconds are a part of available time and are, therefore, counted as available seconds.

sec 20 BER <=	sec 21 BER <=	sec 22 BER <=	sec 23 BER <=	sec 24 BER <=	sec 25 BER <=	sec 26 BER >	sec 27 BER >	sec 28 BER >	sec 29 BER <=

Sliding Window After 29th Test Second Still in Available Time

Even though there were 3 consecutive seconds (the 26th, 27th, and 28th) which each had a BER worse than 10^{-3}, 10 such consecutive seconds are required to make the transition to unavailable time. Those 3 individual seconds are still in available time and they are counted as available seconds.

The 3 seconds with a BER worse than 10^{-3} are also included in the count of severely errored seconds, which are those test seconds with a BER worse than 10^{-3} that occur in available time. A signal loss second or a second in which pattern synchronization is lost is also considered to be a

second with a BER worse than 10^{-3}. Therefore, the current test result values for available seconds count = 29; the severely errored seconds (SES) count = 3, and the unavailable seconds count = 0.

The same test continues to run and remains in available time. In the 80th second, the BER for that second is worse than 10^{-3}. The BER for the 81st, 82nd, 83rd, 84th, and 85th seconds is also worse than 10^{-3}. In the 86th second, pattern synchronization is lost. This also continues for the 87th and 88th seconds. We now have 9 consecutive seconds each of which has a BER worse than 10^{-3}. As each of these test seconds occurs, we are still in available time, so they are counted as available seconds and severely errored seconds. The transition has not been made from available time to unavailable time.

sec 79 BER <=	sec 80 BER >	sec 81 BER >	sec 82 BER >	sec 83 BER >	sec 84 BER >	sec 85 BER >	sec 86 BER >	sec 87 BER >	sec 88 BER >

Sliding Window After 88th Test Second
Still in Available Time

The 89th test second also has a BER worse than 10^{-3}. At this point, the available seconds count = 89, the SES count = 13, and the unavailable seconds count = 0. However, the sliding window now contains 10 consecutive seconds each of which has a BER worse than 10^{-3}. A transition is made to unavailable time.

Those 10 seconds which had been counted as available seconds are deducted from the available seconds count and are added to the unavailable seconds count; the available seconds count becomes 79, and the unavailable seconds count become 10. Those same 10 seconds were also included in the SES count. However, SES is limited to only

sec 80 BER >	sec 81 BER >	sec 82 BER >	sec 83 BER >	sec 84 BER >	sec 85 BER >	sec 86 BER >	sec 87 BER >	sec 88 BER >	sec 89 BER >

Sliding Window After 89th Test Second
Transition to Unavailable Time

those seconds in available time which have a BER worse than 10^{-3}; therefore, those last consecutive 10 seconds must also be deducted from the SES count (the SES count is updated to 3).

Once the transition occurs from available time to unavailable time, all test seconds are counted as unavailable seconds until 10 consecutive seconds occur each with a BER better than 10^{-3}. As the sample test continues, the 90th through 150th seconds each have a BER worse than 10^{-3}. We are still in unavailable time, so these seconds are counted as unavailable seconds; now the total available seconds count = 79 and the total unavailable seconds count = 71.

Beginning with the 151st second, the BER for that second falls below 10^{-3}. It is still counted as an unavailable second since we are still in unavailable time and the transition has not been made to available time. A BER better than 10^{-3} also occurs for the 152nd, 153rd, 154th, 155th, 156th, 157th, 158th, 159th, and 160th seconds. Since there are now 10 consecutive seconds with a BER less than 10^{-3}, the transition is made from unavailable time to available time.

As each of these faulty 10-second intervals occurred, it was added to the unavailable seconds count (unavailable seconds = 81, available seconds = 79, and SES = 3). Now that the last group of seconds has triggered the transition to available time, that group of seconds is deducted from the unavailable seconds count and added to the available seconds count. Now the unavailable seconds count = 71 and the available seconds count = 89.

The monitoring of available and unavailable time continues for the duration of the test.

Degraded minutes is an error analysis result that is affected by available and unavailable time. Degraded minutes is a count of the number of minutes during which an average BER worse than 10^{-6}, but better than 10^{-3}, occurs. The 1-minute intervals are derived by removing unavailable seconds and severely errored seconds (SES) from the total test time and then consecutively grouping the remaining seconds into blocks of 60. The average BER is calculated for the block of 60 seconds and, if it is worse than 10^{-6}, the block is counted as a degraded minute.

In the transition from available time to unavailable time, the degraded minutes result is unaffected. This is because a switch to unavailable time requires 10 consecutive seconds each with a BER worse than 10^{-3}. Any second in available time with a BER worse than 10^{-3} is considered to be a severely errored second and, therefore, not included in the accumulation of seconds used to calculate degraded minutes.

Moving from unavailable time to available time may affect the degraded minutes count. While in unavailable time, 10 consecutive seconds each with a BER better than 10^{-3} are required for the transition to available time. When this happens, those 10 seconds are subtracted from the unavailable seconds count and are added to the available seconds count. Since these seconds are now considered to be a part of available time and they are not severely errored seconds, they are included in the calculation of degraded minutes.

sec 151 BER <	sec 152 BER <	sec 153 BER <	sec 154 BER <	sec 155 BER <	sec 156 BER <	sec 157 BER <	sec 158 BER <	sec 159 BER <	sec 160 BER <

Sliding Window After 160th Test Second
Transition to Available Time

APPENDIX B
REFERENCES

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*SLC is a registered trademark of AT&T Technologies.

APPENDIX C
THE T-BERD T1 CHANNEL MONITOR OPTION

Appendix C fully describes the T-BERD T1 Channel Monitor Option.

Overview

The T-BERD T1 Channel Monitor Option gives the T-BERD 209A the ability to monitor VF channels.

Encased on the inside part of the T-BERD front cover, the Channel Monitor makes it possible to troubleshoot a T1 circuit and monitor the circuit's individual channels with a single test set. While your T-BERD is analyzing a T1 signal, the Channel Monitor:

(1) Displays signaling information for all 24 channels in a T1 circuit.

(2) Decodes any of the 24 channels and sends the Voice Frequency (VF) signal to a speaker.

(3) Displays the voice frequency signal level in an easy-to-read bar graph format.

The Channel Monitor attaches to the T-BERD by connecting the Channel Monitor's 15-Pin "D" power cord to the T-BERD's front-panel BNC connector (see Figure 12).

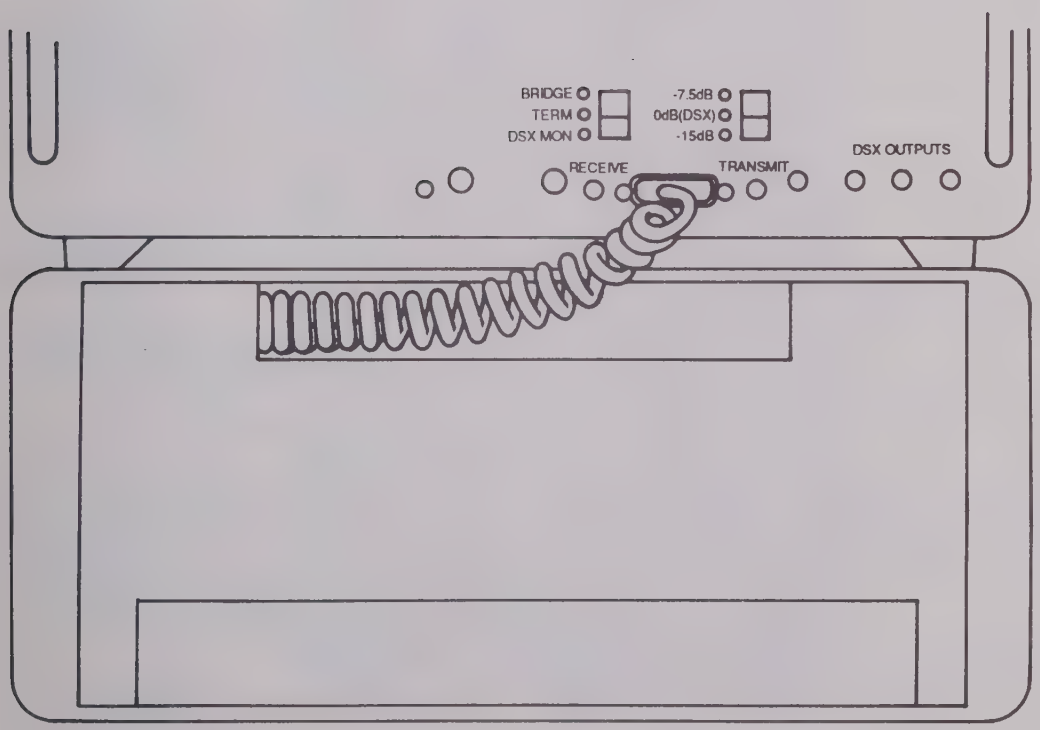

Figure 12 —Connecting the Channel Monitor to the T-BERD 209A

Summary of Key Features

The T-BERD T1 Channel Monitor offers these key features and characteristics:

(1) **Simultaneous Display of All 24 Signaling Bits** allows a "quick look" at the hook status of a channel or a view of the ongoing signaling on a T1 trunk.

(2) **LED Bar Signal Level Display** prominently displays the VF signal level in bar graph format. The display covers the range -54 dBm to +3 dBm in 3 dBm increments.

(3) **Insert and Drop of ESF Data Link** permits access to and monitoring of the ESF data link.

(4) **Drop of SLC-96 4 kb/s Data Link** permits monitoring of the SLC-96 data link.

(5) **VF Output** provides access to an external VF test set via 600 ohm VF output jack.

(6) **ISDN compatibility** can be achieved by dropping any of the 24 64 kb/s channels.

Instrument Description

Figure 13 shows the T-BERD T1 Channel Monitor. The numbers for each item in the figure correspond to the numbered descriptions of the instrument's switches and indicators which follow.

(1) FRAME FORMAT SWITCH

FRAME FORMAT is a multiposition switch that enables you to synchronize to the framing format of the T1 circuit under test. LED indicators show the current setting of the switch.

Using this switch, you can select one of five framing formats: ESF, SLC, D3/D4, D2, and D1D. Note that D3/D4 framing is the default setting at power-up time.

(2) FRAME SYNC LOSS LED

The FRAME SYNC LOSS LED illuminates when the T-BERD 209A is not synchronized to the selected frame format.

(3) CHANNEL SELECT SWITCH

CHANNEL SELECT is a rocker switch that enables you to select the channel to be monitored on your T1 circuit. Channel 24 is always the first channel displayed at power-up time. The channel number is displayed on a 2-digit, 7-segment LED located to the left of the switch. See Table 36 for channel time slot assignments.

(4) SIGNALING DISPLAY

The SIGNALING display is a 4 x 24 LED array that shows the signaling status for each of the 24 voice channels in the T1 circuit. When the ESF framing format is selected, the entire LED array (rows A-D) is multiplexed and updated at the ESF signaling rate 333 times per second). In all other framing formats, only the LEDs in rows A and B are multiplexed and updated.

NOTE: The SIGNALING display is blank during the absence or loss of frame synchronization.

(5) BUILT-IN SPEAKER AND VOLUME SWITCH

The T-BERD T1 Channel Monitor's built-in speaker allows the user to hear the audio output of the voice frequency signal once a channel is decoded. The VOLUME switch located below the speaker controls the volume level, but does not affect the VF output.

(6) DATA BITS DISPLAY

The DATA BITS LED grouping displays the individual data bits for the selected channel in 8-data-bit format.

NOTE: The DATA BITS display is blank during the absence or loss of frame synchronization.

(7) LEVEL (dBm) DISPLAY

LEVEL (dBm) displays the average level of the currently selected VF channel in bar-graph format. Consisting of 20 segments with 3 dB change in amplitude per segment, the bar graph features a "thermometer-style" presentation; the more segments that are illuminated, the greater the channel's amplitude.

(8) CLIPPING LED

The CLIPPING LED is illuminated when either the maximum positive or negative digital VF signal is received while the +3 dB bar graph segment is illuminated). When the CLIPPING LED blinks during normal conversation on the selected channel, it is a signal that the gain at the source may be too high.

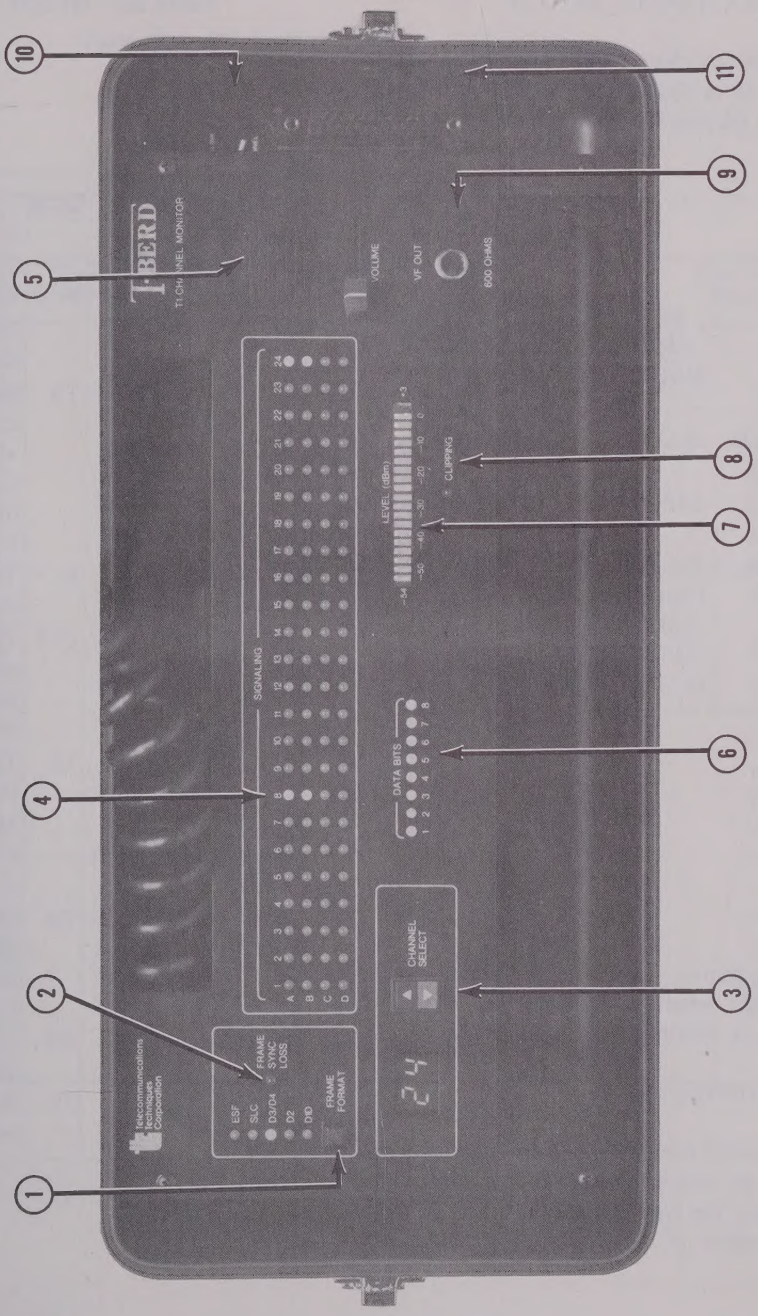

Figure 13 —The T-BERD T1 Channel Monitor

(9) VF OUT 600-OHM OUTPUT JACK

VF OUT is a 600-ohm output jack that allows the currently selected VF channel to be output to an external VF test set for in-depth analysis.

(10) DATALINK/CHANNEL SWITCH

The DATALINK/CHANNEL switch lets you output either the 4 kb/s ESF or SLC-96 data link or the selected channel's data in 64 kb/s format as follows:

TO:	SET THE FRAMING SWITCH TO:	AND SET THE DATALINK CHANNEL SWITCH TO:
Output the SLC-96 Data Link	SLC	DATALINK
Output the ESF Data Link	ESF	DATALINK
Output the Selected Channel's data in 64 kb/s Format	The desired Frame Format (ESF, SLC, D3/D4, D2, or D1D)	CHANNEL

In ESF framing format, data can be inserted on the datalink no matter what the DATALINK/CHANNEL switch is set to, or which channel is selected.

(11) RS-232 CONNECTOR

The RS-232 25-pin D connector collects either data link or channel data for output to terminal equipment (e.g., protocol analyzer). The type of output that is collected is based on the setting of the DATALINK/CHANNEL switch.

The RS-232 connector is configured as a DCE and transmits data synchronously; a transmit clock is supplied with the transmit data, and a receive clock synchronizes the receive data to be inserted into the data link. Table 35 depicts the pin configuration for the RS-232 connector.

Table 35—RS-232 Pin Configuration

SIGNAL	DCE	COMMENTS
PROT GND (Pin 1):	—	Connected to chassis ground.
TX DATA (Pin 2):	RCV	The Channel Monitor receives data on this lead (ESF mode only.)
RCV DATA (Pin 3):	TX	Data is transmitted on this lead; driven to the ON state when ESF, SLC, or CHANNEL is selected, and frame synchronization is achieved.
RTS (Pin 4):	RCV	This lead must be active to insert data.
CTS (Pin 5):	CTS	This lead is driven to the ON state by the T-BERD 209A whenever it is ready to receive a command.
DSR (Pin 6):	TX	This lead is driven to the ON state when POWER is applied.
SIGNAL GROUND: (Pin 7)	—	Connected to signal ground.
RLSD (Pin 8):	TX	Driven to the ON state when ESF, SLC, or CHANNEL is selected, and frame synchronization is achieved.
TX CLK (Pin 15)	TX	Synchronizes data for data link insert.
RX CLK (Pin 17)	TX	Reclocks ESF, SLC, or selected channel.

Table 36—Channel Time Slot Assignments

Channel Time Slot:	D1D Channel Number:	D2 Channel Number:	D3/D4 & ESF Channel Number:	SLC Channel Number:
1	1	12	1	1
2	13	13	2	13
3	2	1	3	2
4	14	17	4	14
5	3	5	5	3
6	15	21	6	15
7	4	9	7	4
8	16	15	8	16
9	5	3	9	5
10	17	19	10	17
11	6	7	11	6
12	18	23	12	18
13	7	11	13	7
14	19	14	14	19
15	8	2	15	8
16	20	18	16	20
17	9	6	17	9
18	21	22	18	21
19	10	10	19	10
20	22	16	20	22
21	11	4	21	11
22	23	20	22	23
23	12	8	23	12
24	24	24	24	24

PLEASE NOTE

FAILURE TO RETURN THIS MANUAL WILL RESULT IN A MINIMUM BILLING CHARGE OF **$50.00.**

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